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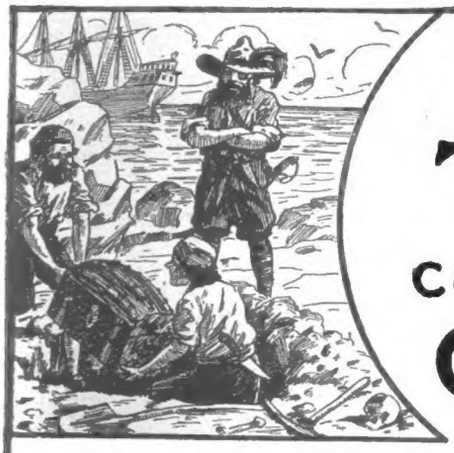

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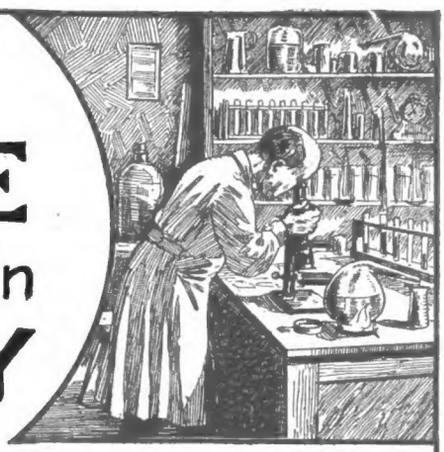

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Science and Invention

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January, 1927
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Lodge "N" Circuit

Owing to further necessary research on the "N" circuit receiving set, the article describing it was deferred to the next number.

The Indian Rope Trick

Greatest of all tricks in magic explained on a new basis

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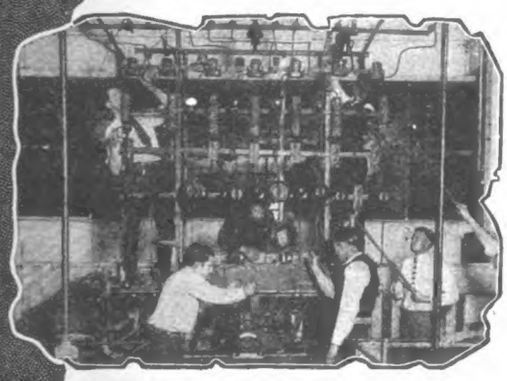

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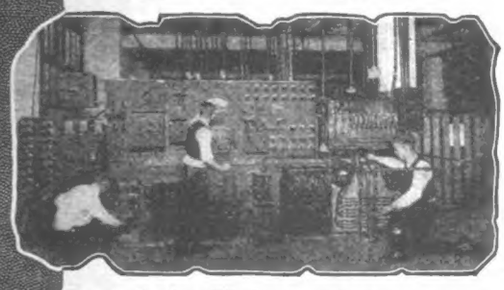
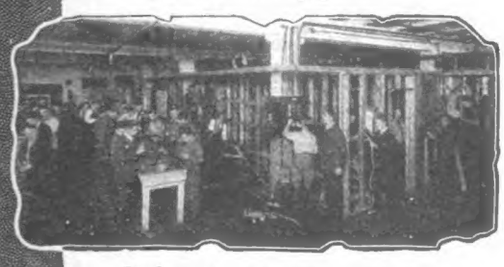


Students Working on Massive A. C. Control Equipment.



Students Practicing House-wiring In Skeleton Houses.

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Why work for a small pay. Why make $25.00 or $30.00 or even $40.00 a week in a hard job doing dirty disagreeable work, and never sure of your job. As a Coyne TRAINED ELECTRICAL EXPERT you can make $200 to $800 a month. You will do pleasant work, with chance to travel, and advancement will be quick. Steady work the year around. YOUR SERVICES WILL ALWAYS BE IN DEMAND ANY PLACE, or you can own your own business and make up to $15000 a year.

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Get into the great new Big-pay Industry—Radio. If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you? I'll train you just as I trained them—just as I trained the men whose letters you see on this page. I'll teach you quickly at home in your spare time to be a Radio Expert, and draw down big money for the easiest and most fascinating work in the world.

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All instruments shown here and others sent to all my students free of extra cost under short time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work.

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Read the true stories printed in this border—of men who got out of the rut

Chief Engineer Station WEMC

"Please communicate with my two junior operators here who want to increase their knowledge of Radio. Being a graduate of your course I know they could do nothing better for themselves than study it for it is the way to success in this profession." John E. Fetzer, Chief Engineer, Station WEMC, Berrien Springs, Michigan.

Photo shows Graduate E. F. Spadoni in his own Radio store at Chicago, Ill. "Your course gets the credit," says Spadoni.

My Radio Training is the "Famous Course That Pays for Itself"

Make more money quick when you take up this practical course. I show you how to increase your earnings almost from the start of your course through practical pointers I give you.

Howard B. Luce of Friedens, Pa., made $320 in 7 weeks during his spare time. D. H. Suitt of Newport, Ark., writes "While taking the course I earned in spare time work approximately $900." Earl Wright of Omaha reports making $400 in a short time while taking his course—working at Radio in his spare time only! Sylvester Senso, 207 Elm St., Kaukana, Wis., made $500. These records not unusual—these men are a few of hundreds.

And when you graduate, my big Free Employment Department helps you get the job. You get just the same preparation and assistance toward success we gave C. C. Gielow, Chief Operator of the Great Lakes Radio Telegraph Co., E. W. Novy, Chief Operator of Station WRNY, Erle Chambers, Radio Engineer for Stewart-Warner, J. E. Fetzer, Chief Engineer of Station WEMC. The National Radio Institute, established 1914, today offers you the same opportunity these men had under a bond that guarantees you full satisfaction or money refunded. It's your big chance to get into the great Radio field—mail coupon TODAY for my big Free Book and proof!

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Most amazing book on Radio ever written—full of facts and pictures—tells all about the great Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

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$70 in one Day for T. M. Wilcox

"I am in business for myself and recently made $70 in one day. I was an electrician of rich experience and was occupying a splendid position as telephone superintendent when I enrolled with your course believing it would open up greater opportunities—have not been disappointed. Estimate that Radio will be worth tens of thousands of dollars to me in the next few years." T. M. Wilcox, Belle Island, Newfoundland.

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Kimball With WMAQ Chicago

"Accepted a position with the Chicago Daily News Station WMAQ. My income practically doubled, thanks to your fine course. I handle all consultation also do operating." Keith Kimball, Station WMAQ, Chicago, Ill.

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"Just been made Sales Manager of this Radio firm—received a very good increase in pay. Up to present have been getting salary which in 3 months enabled me to purchase a new car.." R. Jones Bay City Mich.

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Dear Mr. Smith: Without obligating me in anyway, send me your free book "Rich Rewards in Radio" and all information about your practical, home-study Radio course.

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Street Address.....

Town.....State.....

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Whole No. 165

Science and Invention

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No. 9

HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
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Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

LIFE ON OTHER WORLDS

By HUGO GERNSBACK

THE age-old question, "Is it possible for life, as we know it, to maintain itself on other worlds?", apparently never ceases to excite the imagination of the multitude. There is hardly a week passes in which I am not asked this question in one shape or another, and the random thoughts on the subject set down here constitute my own ideas in the matter.

To many scientists, and indeed many philosophers, it would seem that conditions for life, as we know it, are unique and must have certain requisites before life can appear. For instance, it is pointed out that no organisms can live in a vacuum, and in order to support life there must be some sort of atmosphere. It must not be too cold, because, as we approach the temperature of outer space, life can no longer be supported. It must not be too hot, because nothing can live above the boiling point of water. These, roughly speaking, are the conditions for maintaining life as we know it.

I have said several times, life *as we know it*, for the reason that there might be life in other forms of which we are totally unaware, It has been determined, for instance, that an organism can live in ice and in cold close to the absolute zero. Svante Arrhennius, the famous scientist, maintained that it is possible for life-bearing spores to be transported through outer space by the pressure of light, and when such spores fall upon a world where the conditions are right, life will spring forth on such a world.

We also know that life can exist close to the boiling point of water. It thus takes, several hours of boiling to effectively kill Anthrax germs.

These are forms of life as we know them. There might be other forms of life of which we can not even form a conception. It is quite conceivable that life may be found in a gaseous medium, and it is even possible that it may be found embedded in solids.

Up to a few years ago, it was believed that life could not be maintained under extraordinarily high pressures. This view was totally exploded when our deep sea fishing expeditions got busy and brought up fish from the bottom of the ocean, where they seemed to get along rather nicely under enormously high hydraulic pressures, which would instantly kill the usual organisms.

Life always adapts itself to environment, as is well understood by every scientist. No matter how adverse the conditions, no matter how nearly impossible the surroundings, some form of life will always find it possible to maintain itself. We have learned so much about extraordinary forms of life during the past few decades that scientists are becoming more and more cautious. For instance, fifty years ago the idea that life could maintain itself on the practically atmosphereless moon was ridiculed. Today it is believed that some form of life exists on the moon, even if it has practically no atmosphere and even if the organisms will have to live almost in a vacuum.

It should always be understood that, due to our peculiar surroundings, our entire thoughts and logic as to life on other worlds necessarily becomes very much warped when we think of conditions there. It is also highly probable that life exists, just as it does on the earth, on practically all of the planets of our own solar system. This includes all of the planets, even those on which a thick crust has as yet not appeared, such as, for instance, Jupiter, Saturn, and some of the other planets. These latter are still thought to be quite hot, but it is conceivable that even here *some* form of life may be found.

Even on far away Neptune, engulfed, probably, in a temperature of absolute zero, some form of life may be found.

It is the height of foolishness to believe that out of billions of worlds in all the millions of universes our puny earth should have been selected as the only world fit to bear life and intelligence! Nature never works in singles. The same conditions as found on the earth will be found elsewhere with variations. Practically every metal, practically every gas, and practically every substance that we know of, can be found by means of the spectroscope in our own sun and in every sun throughout the entire universe. There are no exceptions. These are facts, not theory.

On the other hand, every star which we see in the skies is a sun, the same as our sun, and the chances are that each of these suns has its own planetary system, with variations, as has our own earth. On millions of these planets, conditions must be a close duplicate of those on our own earth, that is, as far as physical conditions are concerned, and if such conditions are duplicated, there is not a shadow of a doubt that life, just as we know it here, will be found on such planets, no matter how far removed, and no matter to what universe they belong.

It is not even necessary to consider Arrhennius' theory of propagation of life throughout the universe, because my own opinion as to the origin of life is that whenever the conditions in any world are right, life will appear of its own accord. On our own earth we can not find the dividing line between animal and plant, and between plant and seemingly lifeless objects. We have forms of life which are half plant and half animal, and we likewise have other forms of life half plant and half solids.

Just what conditions made this life possible we do not, as yet, know. It is quite probable that in the not-too-far-distant future it will be possible for man to produce some form of life synthetically. Indeed, we have approached this quite closely in our laboratories already. Whenever the chemical and physical conditions are just right, it must be assumed that life springs into being.

Furthermore, the older a world becomes, the more advanced and the greater its life-bearing species will become, and the more variegated. Nature always tries the hit-or-miss system, and sometimes advances only to retrograde afterwards. For instance, in point of size, life on earth today may be said to be retrograding, because the huge monsters of the dinosaur and mammoth types have been exterminated, because these monsters could no longer maintain themselves in our present environment. If the climatic changes of the earth should violently alter themselves and make the whole planet tropical once more, the same huge beasts would roam the earth again. In my mind there is no question at all that beasts of the type of the Brontosaurus, Pterodactyl, and other prehistoric beasts, are at the present time roaming about upon thousands of distant planets, somewhere, in some universe.

The foregoing considerations will show why it is that many students of the subject are interested in signaling Mars and other planets. If there is life on other planets we would like to know it. The only way in which we ever shall know is to attempt sending signals of different kinds from time to time, and see if we receive any answering signals. Just what kind of signals to flash constitutes an interesting problem in itself, but one quite worth while from the scientist's viewpoint. It would not be surprising if we received some sign of recognition from another planet within the next fifty years.

Therefore our science students will find plenty to interest them in philosophizing on whether or not distant planets are inhabited.

THE GOLDEN AGE OF SCIENCE

is symbolized by the golden cover OF SCIENCE & INVENTION LOOK FOR THE GOLD COVER every month!

Mr. Hugo Gernsback speaks every Monday at 9 P. M. from Station WRNY on various scientific and radio subjects.

New York Telephone Company
Has Largest Home of All.

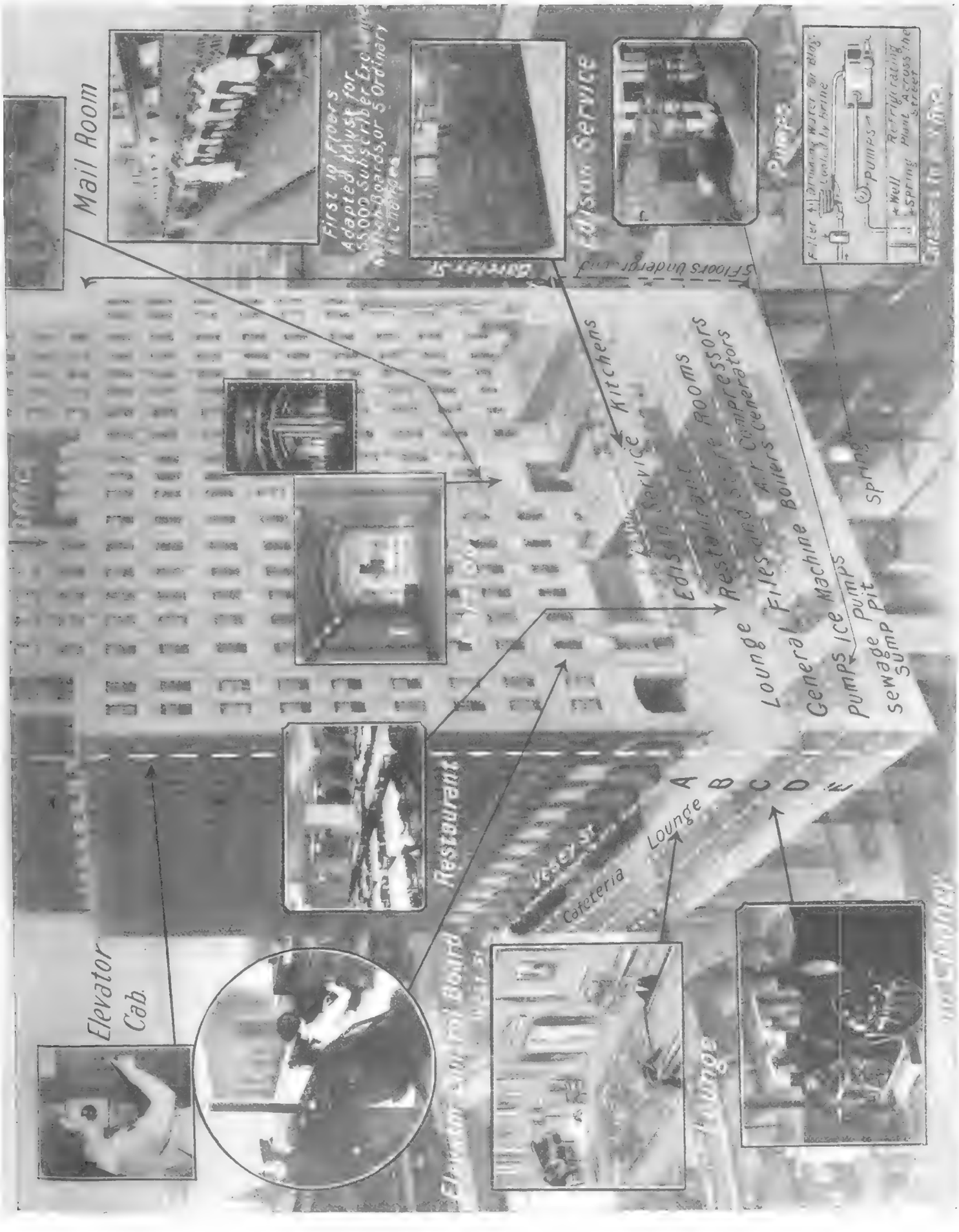
The Greatest Telephone

See Text Description

Building on Earth

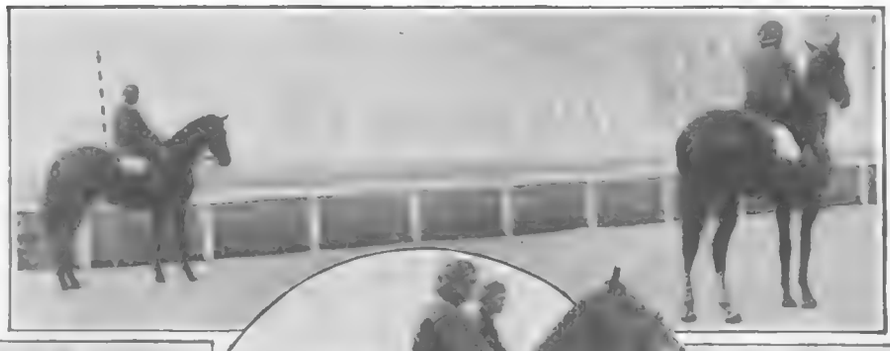
on Following Page

Huge Central and Office Building Houses 6000 People



Why People Argue with Race-Track Judges

WE have all heard the adage, "Don't believe all you see." This is particularly true at the race track. Nothing is more common around a race track than to hear an angry fan say "I know that my horse won by a half length, but those judges gave it to the other horse." To show you how easily your own eyes can deceive you, the photographer took pictures of two horses from four different angles.



IN all of these photographs no change was made except that an extra saddle cloth was added in some of the views. The scene at the left shows how you would watch horses going away from you toward the finishing line. It would appear that the horse at the right is considerably in the lead. There is plenty of open space between the two horses. The question of course arises as to whether the horse is actually ahead.

This photograph is taken from about the same distance beyond the finish as the one on top was taken in back of the finish line. Matters are now reversed and horse at the right appears to be leading.

How the horses actually stood while these photographs were being taken.

This is a view taken still farther past the wire and it gives the horse an apparent lead of what looks like several lengths over his rival.

THE next time you are at a race track and either to one side or the other of the finishing line, do not be too sure that the horse you believe wins the race has actually won it. The judges are so placed that they view the track from one end of the finishing line itself and consequently they are in a position to state exactly which horse won; whereas in a position either to one side or the other of the finish line the race appears to have been won by a horse not named by the judges. In all four of the above pictures, the horses stayed in approximately the same position or at least as near this as it is possible to have two horses remain. One did not move ahead of the other for a distance of even a foot. It is obvious that the only persons who could have told how the horses had actually finished had they been running a race, would have been the placing judges and any others exactly in line with the post. The next time you see a race, think of these pictures and give the judges the credit for their opinion.

Greatest Telephone Building on Earth

By H .WINFIELD SECOR

(Illustration on preceding page)

A VISIT to the greatest telephone building on earth, the new thirty-two story edifice erected by the New York Telephone Company at the lower end of Manhattan, New York City, bounded by West, Vesey, Washington and Barclay Streets, is indeed a marvel of the latest architectural skill and engineering. This building was erected in record time, and to do justice to the many features incorporated in this remarkable structure one should devote an afternoon to a personally conducted tour through the building. We started at the thirty-second story and worked our way down through the building. Way up at the top where you see the high arched windows, there is located a large and very beautifully finished lecture hall or auditorium. This lecture hall is fitted with the latest style motion picture projector, as much instruction is given to telephone classes here. I nearly forgot to mention the secret panel doors in the Board of Director's room, shown on the preceding page; back of each panel when you press it, there is revealed a wardrobe. Next we visited the wonderful elevator motor room at the top of the building, and saw the automatic switching and interlocking devices, which control the automatic elevators as they sweep skyward at eight hundred feet a minute. There are 24 passenger and 2 freight elevators. The operator pushes the button for the floor you ask for, and the elevator comes to rest exactly at the floor, she simply operates a lever which closes the doors. The travel of every elevator can be watched by a series of lights in the dispatcher's office, shown in photo on preceding page. The cars can be changed from local to express or vice versa, at the dispatcher's will.

The medical department personnel includes several doctors, specialists and nurses; aided by the latest X-ray equipment, together with a chemical laboratory and dental department. Vacuum cleaner service is supplied throughout the building, all pipes leading to the basement where the dust, and also all waste from the restaurant kitchen, is incinerated or burned. Probably the largest underground restaurant in the world is found here, two stories below the street. A very handsome men's lounge one block long is found here also. A spring which could not be dried up supplies water to a customer across the street who returns brine, which cools the drinking water for the building. Manp other springs were found at the floor level of basement E, but all were dried up by pumping. The building is a pretty sight at night, the upper floors being flood lighted.

One is always interested to know what workmen will find when they dig down deep into the earth, while excvaating for a building of this nature. After having constructed a cofferdom of caissons bounding the lot which was to serve as the position for the foundation of this building, workmen brought to light an ancient water main, dating back to the early Dutch settlers, at a depth of 6 feet below the surface. About 20 feet below the surface a Hudson River boat with solid oak beams in a wonderful state of preservation was located. Coins dating back to 1783 were found, also a ram's skull of a species which never inhabited America.

OUTSTANDING FACTS

Ground dimensions: approximately 200 by 250 feet.

Height: 486 feet, with five floors below ground level and thirty-two stories above ground, not including the two highest stories in the tower roof.

Usable floor space: 850,000 square feet, providing room for 6,000 workers.

Demolition of old building began May 23, 1923; completed July 14, 1923.

Over 15½ miles of heavy timber used in the criss-cross supports in the building foundation.

600 tons of steel rods used to reinforce the concrete walls lining the excavation. 5,000 tons of steel used in structural steel work below ground level, and 15,000 tons above ground.

Concrete used in the construction of each floor would build a sidewalk 1¾ miles long and 5 feet wide.

285,000 rivets driven and 7,000 gallons of paint used on the steel girders and uprights alone.

Large medical department especially for employees including latest X-ray equipment.

High speed automatic electric elevators, 24 passenger and 2 freight.

40 tons coal used daily to heat building, enough to heat four average homes all winter.

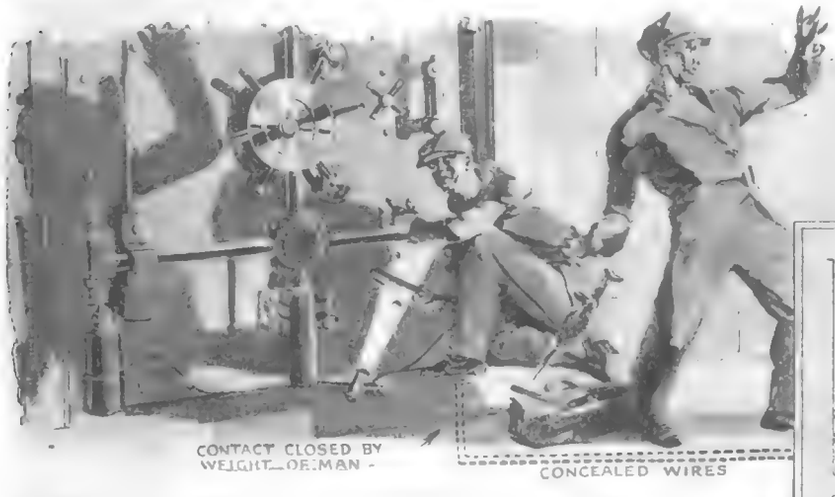
First ten floors designed for telephone switchboards to care for five exchanges or 55,000 subscribers.

Huge restaurant two stories underground, including cafeteria and a lounge one block long.

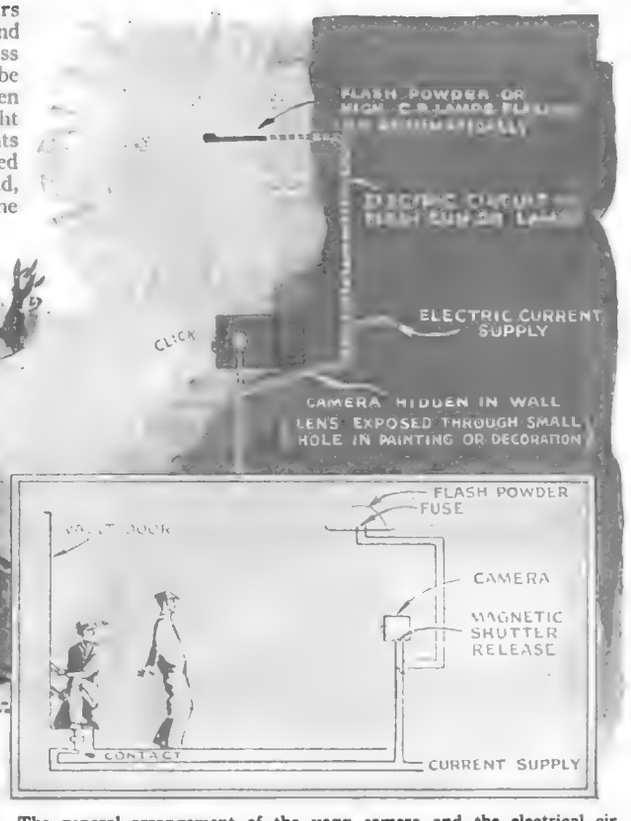
Vacuum cleaner system piped throughout building and ice water piped to every floor.

Foiling the Safe-Cracker

SAFE-CRACKERS or yeggmen cost the country many thousands of dollars yearly and engineers and electricians, not to mention photographers and many other experts in applied science, have tried their hand at fooling this class of "frenzied financiers." The picture herewith shows the latest method to be put in use for this purpose, and it involves the use of a camera carefully hidden in the wall. Also there is a suitable source of illumination, such as a flashlight or high candlepower electric bulbs, the camera being tripped off and the lights flashed on simultaneously, by means of an electric contact unconsciously closed by the yeggmen. This scheme comes from the fertile brain of John E. Seebold, of La Salle, Illinois, and ten of the machines are being manufactured by the well-known Gundlach Optical Works at Rochester, N. Y.



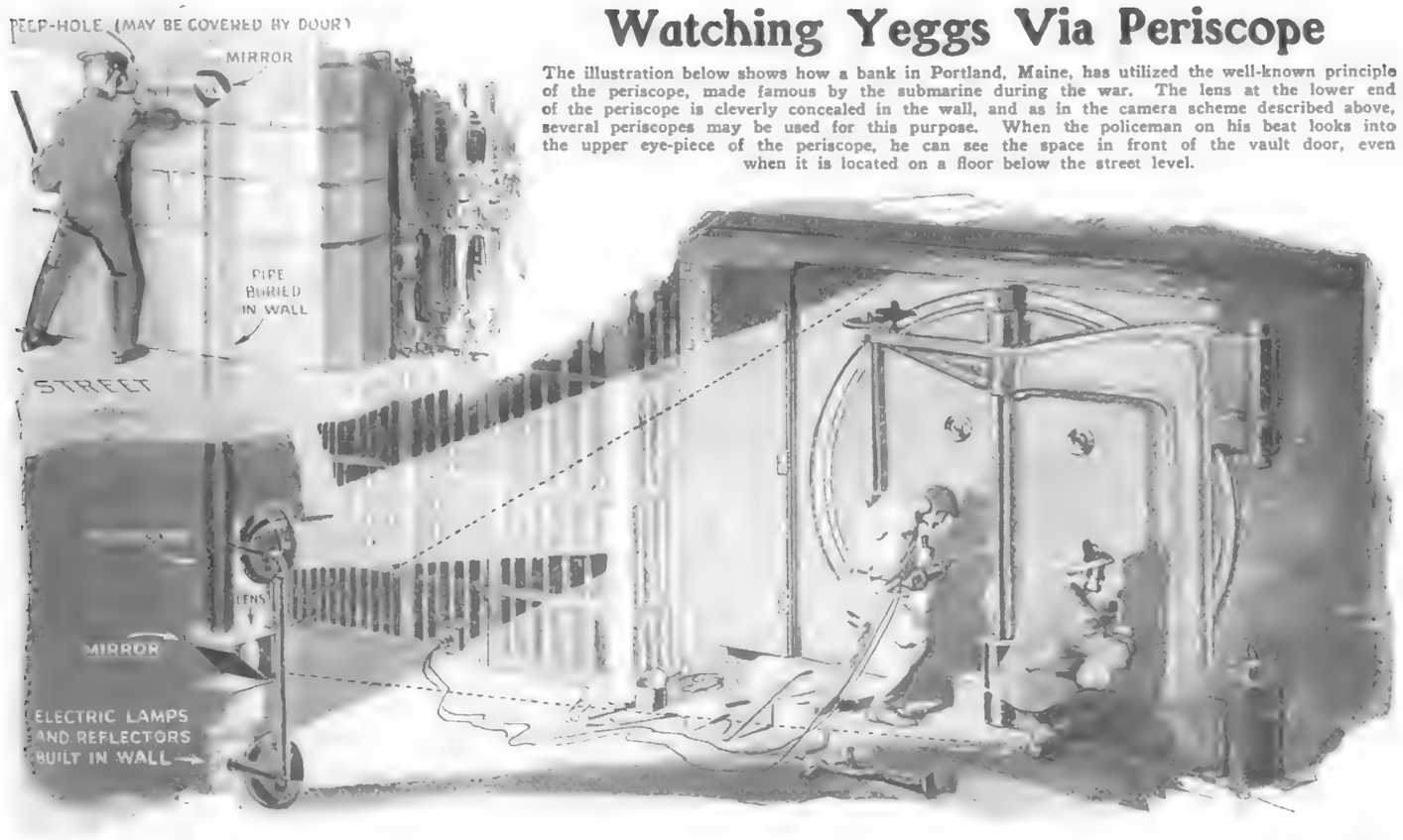
ABOVE we see the surprised safe-crackers at the moment that a powerful light flashes on the scene of their activities, while a hidden camera in the wall photographs them. The camera is to be placed in a small compartment of its own, and the picture taken through a small opening which may be in the form of a rosette, or other decoration, forming part of the moulding around the wall. If there is anything that a crook hates, it is to have his face snapped by a camera, and particularly right on the job.



The general arrangement of the yegg camera and the electrical circuits for simultaneously setting off flash powder to take the picture, is shown in the diagram above. Of course it will be obvious that the best way to apply this scheme is to install more than one camera in the walls about the bank, so as to be sure to catch the crooks' faces.

Watching Yeggs Via Periscope

The illustration below shows how a bank in Portland, Maine, has utilized the well-known principle of the periscope, made famous by the submarine during the war. The lens at the lower end of the periscope is cleverly concealed in the wall, and as in the camera scheme described above, several periscopes may be used for this purpose. When the policeman on his beat looks into the upper eye-piece of the periscope, he can see the space in front of the vault door, even when it is located on a floor below the street level.



THE periscope scheme illustrated above has been put to practical use in a bank at Portland, Maine. As the illustration shows a glorified periscope or several of them, are built in the walls about the vault chamber. The lenses both at the street peep-hole and at the lower end, are cleverly arranged so as not to be noticeable offhand. The image is transmitted by means of prisms or mirrors up through the tube, while the vault compartment is lighted by powerful lamps built strongly into the walls. The clever crook will try to beat this scheme by working behind a canvas containing a painting of the door, but several periscopes will probably fool him.

MUSCLE READING

Dunninger Locates Hidden Objects by "Reading" Twitches of Muscles

Miss Crystal Spencer and "Dunninger" demonstrating one method of performing muscle reading.

Another way in which muscle reading can be performed. Miss Spencer is holding "Dunninger's" wrist.

PEOPLE have often wondered how it was that a magician or some other individual gifted with what he sometimes prefers to call his *sixth sense* can locate a concealed object. The answer to the question is that the demonstrator employs what is known to the profession as *muscle reading.* It is considerably easier to explain the effect than it is to go out and produce it. The latter requires many months of practice with a multitude of persons. If the person demonstrating the effect informs his spectator as to what he is going to do, the spectator invariably tries to trick the demonstrator. While this effort at trickery is sometimes successful, it more frequently enables the muscle reader to locate the concealed object with even greater facility.

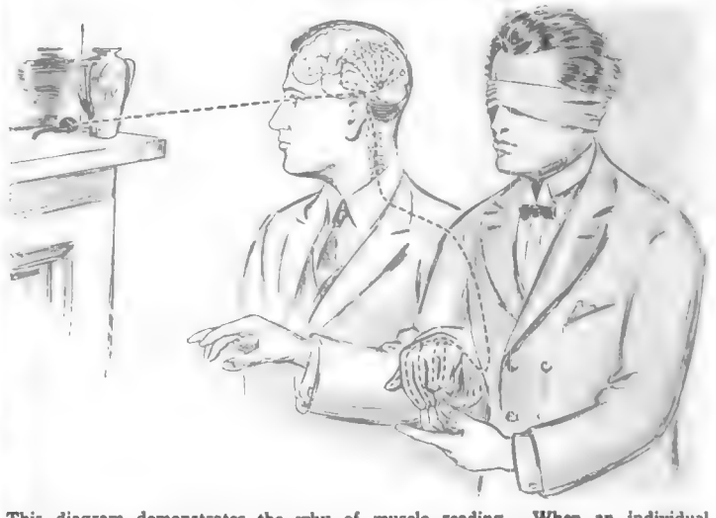
IN the photographs on this page we see the internationally famous "Dunninger" who writes exclusively for SCIENCE AND INVENTION Magazine, demonstrating how muscle reading is performed. The reader will observe that there are several methods at the disposal of the demonstrator, in one of which he may lightly touch the fingertips of his subject, who in the photographs at the top of this page is the well-known actress, Miss Crystal Spencer. Another method available is to have the subject grasp the muscle reader's wrist.

A practical demonstration of muscle reading. "Dunninger" blindfolded, is about to enter a car on a city-wide search for a concealed object.

THE performer must be on the alert for many things. He must be able to sense a slight guiding movement toward the concealed object, or a tug away from the concealed object, and he must know by a sort of an innate sense whether the person who concealed the object is deliberately trying to disuade the muscle reader from the place of concealment of the object, or whether he is subconsciously guiding him to the object. He must be careful to register the kind of breathing which is normal to the spectator and how this breathing will change if the demonstrator approaches the concealed object.

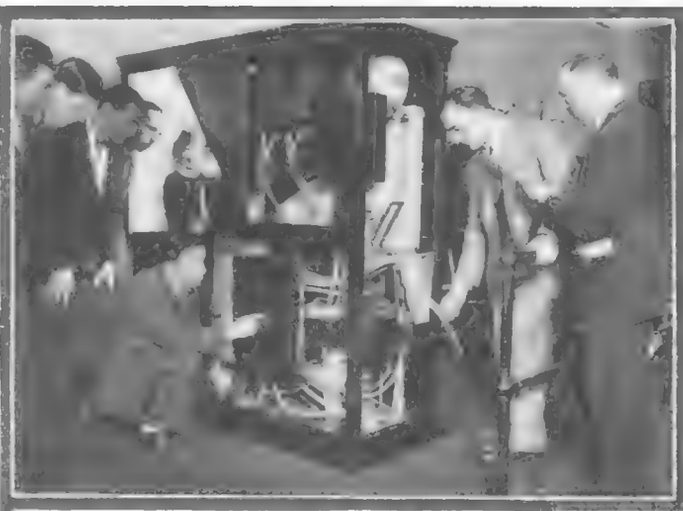
ONE can obtain an idea as to how broad this field may become by examining the photograph at the left and the one below. An object was concealed in an officer's hat at a busy intersection in a large eastern city. After guiding the automobile through the streets, Dunninger, although blindfolded, located the hidden coin.

The termination of a city-wide search, the object being found in an officer's cap. A road intersection presents a particularly unfavorable spot for concealing an object. Arrow points to Mr. Dunninger.



This diagram demonstrates the why of muscle reading. When an individual conceals an object he knows exactly where that object is located. Subconsciously the brain causes the muscles of the arm and fingertips to react when the individual approaches the object. The demonstrator must be prepared to act on these involuntary twichings or muscular contractions, and from them locate the missing object. The dotted lines indicate the path of the impulse from the brain to the fingertips.

Slot Machine Makes Perfect Portraits



Quarter in Slot and Photomaton Delivers Eight Pictures

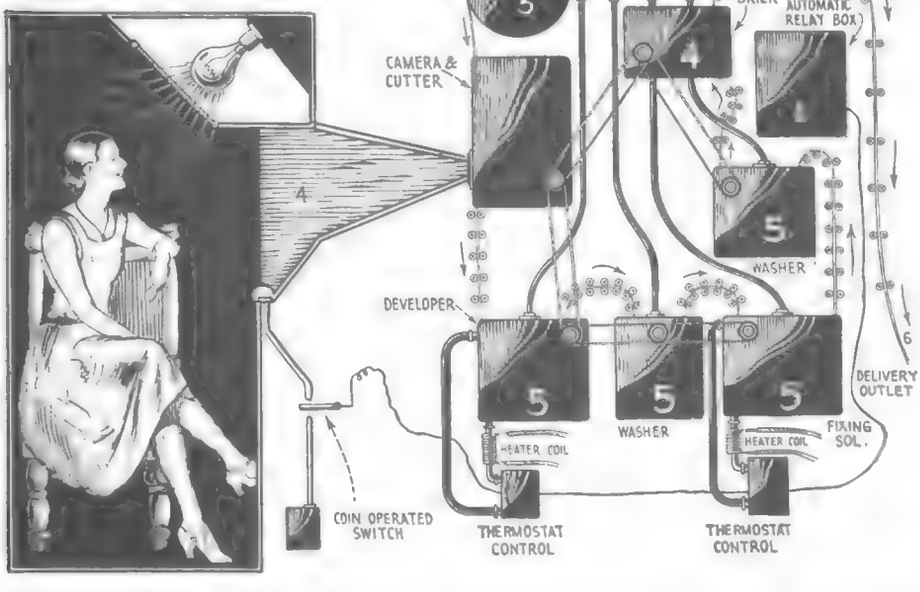
AT the left is the new automatic camera, with the inventor demonstrating the operation of the mechanism which is exposed for inspection by the removal of the side panels. The Photomaton delivers eight finished photographs in a strip, each approximately 1½ times the size of those illustrated at the extreme left. The complete operation, requiring a pose of 20 seconds, occupies 8 minutes, but the operation of the machine is continuous and is not held up for any one set of photographs.

The images are printed upon positive print stock, which is cut, washed and dried automatically before delivering to the customer.

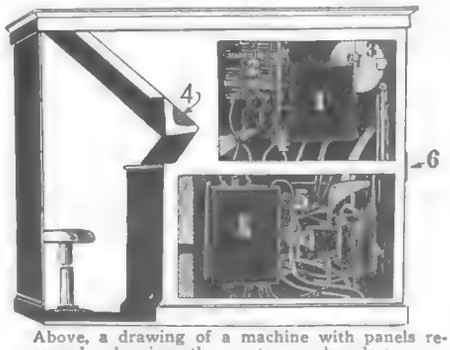
THE latest after-theatre fad for Broadwayites is to drop into a small studio at 1659 Broadway where a number of exceedingly ingenious machines have been installed as a commerical venture. This machine is an automatic, self-operating camera, called the Photomaton, which is the product of the ingenuity of a young Russian inventor Anatol N. Josepho, who has many patents on improvements in photographic processes to his credit. Since his arrival in this country three years ago, Mr. Josepho has concentrated his attention upon making possible a coin-operated camera which would be entirely automatic in action and which would produce thoroughly artistic portraits at a moderate price. In its final form, the Photomaton shows promise of utility in making passport photos, in criminal identification, and in numerous fields separate from that which it now covers. In the first 5 days of operation, 7,500 blasé New Yorkers hiked into the studio, dropped their quarter in the slot, and departed with a pleased grin, bearing 8 perfect miniature portraits of themselves in as many poses.

The young lady in the photograph above is removing her strip of portraits from the window to which they are delivered, finished and perfect in their photographic accuracy, in eight mintes.

The illustration above does not do justice to the work of this machine, due to the fact that all photographs lose clearness in reproduction. The original photos measure 1¾" by 1⅞", and may be enlarged 30 times without loss of definition.



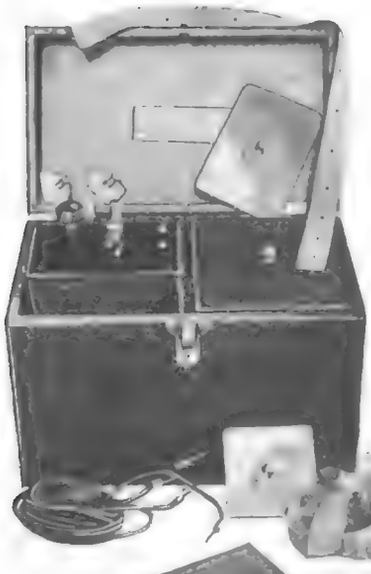
The drawing above shows an extended view of the apparatus contained in the automatic camera. The paper is specially prepared positive stock, which is stored in a magazine (3) until it is required for use. The strips are exposed and cut by the camera, after which they pass through the developer, washers and (4) fixing solution (5) thence to the electric dryer and the delivery outlet. Sufficient solutions for three weeks' use are stored in the reservoirs (2). The automatic relay box (1), controlled by the coin operated switch, starts and stops the entire apparatus.



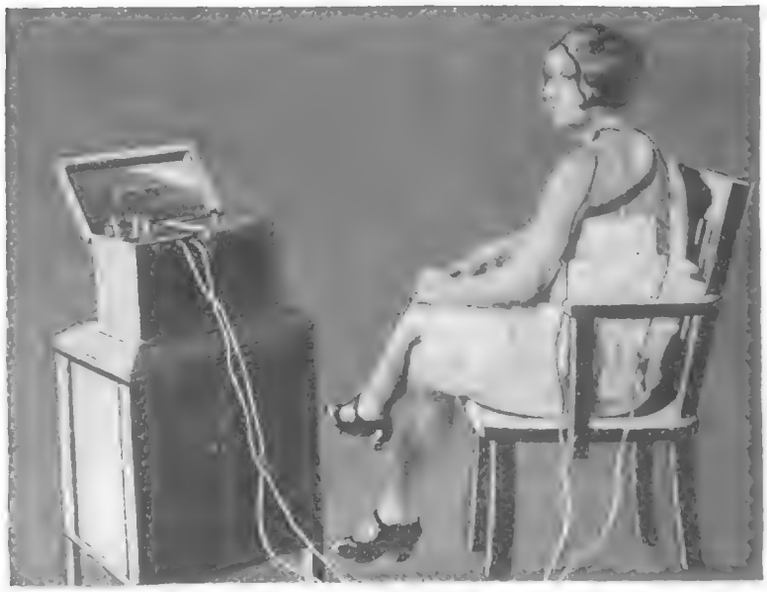
Above, a drawing of a machine with panels removed, showing the parts numbered to correspond with the diagram at left. Below, the appearance of the "business end" of the apparatus. No tiresome posing is necessary.

Beware the Fake Radio Doctor

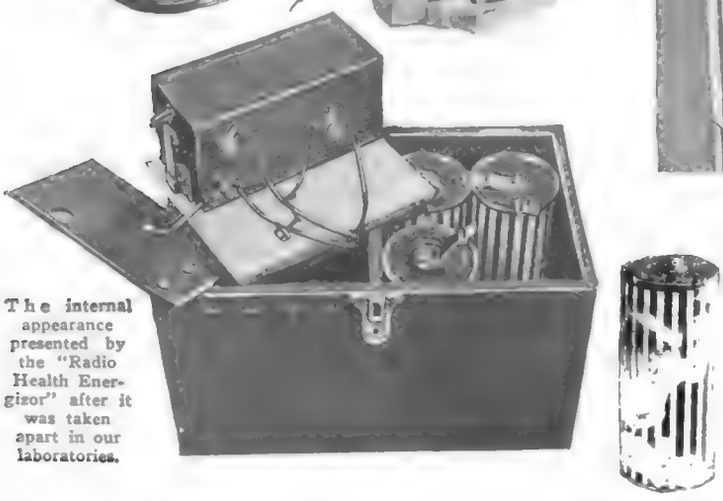
By HUGO GERNSBACK
MEMBER AMERICAN PHYSICAL SOCIETY.



Left: When the cabinet of the "Radio Health Energizor" is opened, it presents this view. The knob at the back regulates the vibrator of the spark coil. The spark gap is to the right of this knob.



How treatments are supposed to be effected by the aid of what Dr. H. M. Farnham and his "Laboratories" located at Detroit, Mich., prefer to call a "Radio Health Energizor." This method of taking treatment is here being demonstrated by Miss Gene Livio. It will be observed that two electrodes are applied over moist gauze pads and connect directly with the operating mechanism. And this remarkable force which ostensibly stores up vital energy in the body and which, according to one of Dr. Farnham's pamphlets cannot injure you, even if you overtreat yourself, is radio!



The internal appearance presented by the "Radio Health Energizor" after it was taken apart in our laboratories.

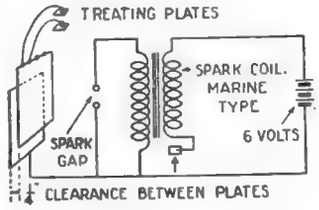
RADIO has come in for a good deal of abuse since it took the public by storm. We have Radio Tires, Radio Shoes, Radio Hats, Radio Razor Blades, and even Radio Restaurants. Such terms as these are harmless publicity stunts, which do nothing worse than arouse an occasional smile. The public has been taught to expect wonders from radio and even well-educated people have come to think that nothing is impossible for radio.

But of late a crop of fakers has come along that exploit the gullible with *radio cures*. It may be set down as an axiom at the present time, that if you receive a pamphlet or see an advertisement of any doctor or medical institution which promises cures, wherein the instrumentality of radio is used, *you should make up your mind immediately that such are pure swindles* and not worthy of any serious consideration.

SCIENCE AND INVENTION has in the past exposed a number of medical frauds, while its sister magazine, RADIO NEWS, is now actually being sued for one million dollars by one "Dr." George D. Rogers, of San Antonio, Texas, for exposing a radio swindle. The Rogers machine, *which was supposed to cure all ills*, was nothing but an ordinary radio outfit, which was connected to a metal headpiece. It was claimed that almost every kind of disease could be cured with the contraption. Needless to say, the thing was a fraud.

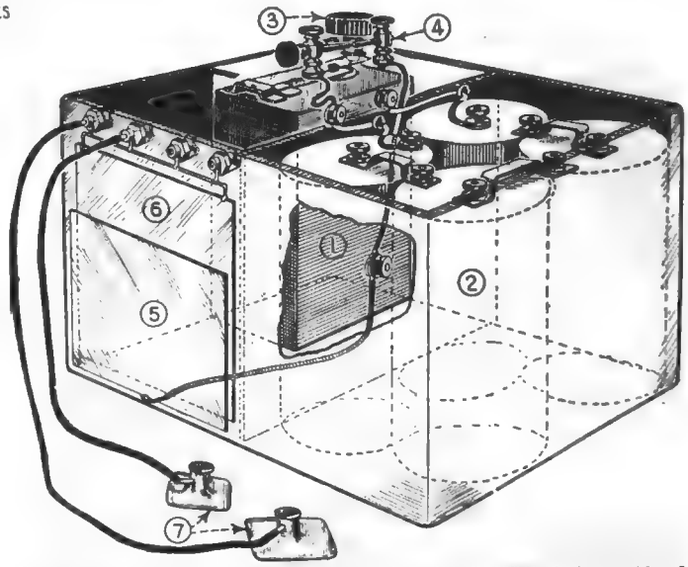
Of late the exploiters of public gullibility

(*Continued on page* 850)



The circuit diagram of this hoax. The usual condenser is placed across the vibrator points.

Actual reproduction of the cover of the pamphlet distributed by the Dr. Farnham's "laboratories." Note his claim "Radio applied to health, success, beauty and youth."

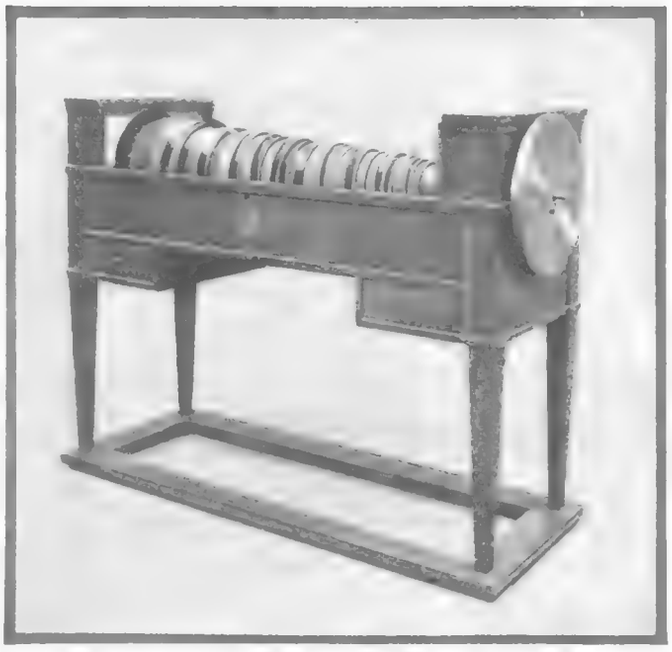


Here is the layout of the "Radio Health Energizor." While it is considered a remarkable piece of engineering by the manufacturers, any technical man will realize that it is nothing more than a joke. 1 is a marine type (common ignition) spark coil. The secondary lead goes to the spark gap, 4, and to a metal plate, 5. This plate acts as one side of a condenser the other side being plate 6 to which the treating electrodes, 7, are attached. 2 is the battery compartment in which are found four dry cells and 3, the knob for adjusting the vibrator.

Benjamin Franklin's Armonica

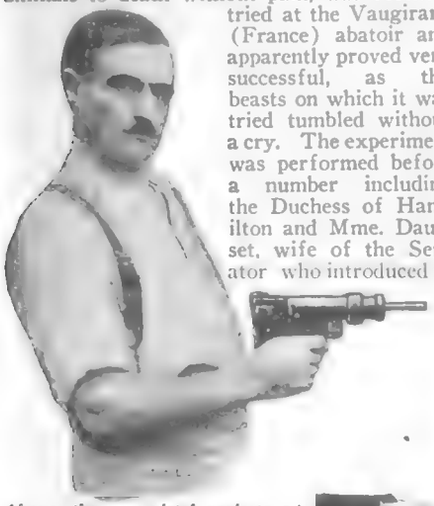
Franklin's Armonica is played by touching the wet finger-tips to the edge of glass bowls revolved by a treadle.

Benjamin Franklin, patriot, overshadows Benjamin Franklin, musician, in the mind of the average person. In fact, very few people realize that Franklin was a song-writer, a harpist, played the guitar and the violin, and even invented a musical instrument. This remarkable instrument, the original of which is shown in the photograph at the right, consists of a series of glass bowls mounted on a common shaft and rotated by means of a treadle. The various tones are produced by touching the wet tips of the fingers to the revolving bowls, each bowl being tuned accurately to the required pitch.



Painless Slaughter

A huge steel pistol, which it is claimed puts animals to death without pain, was recently tried at the Vaugirard (France) abatoir and apparently proved very successful, as the beasts on which it was tried tumbled without a cry. The experiment was performed before a number including the Duchess of Hamilton and Mme. Dausset, wife of the Senator who introduced it.



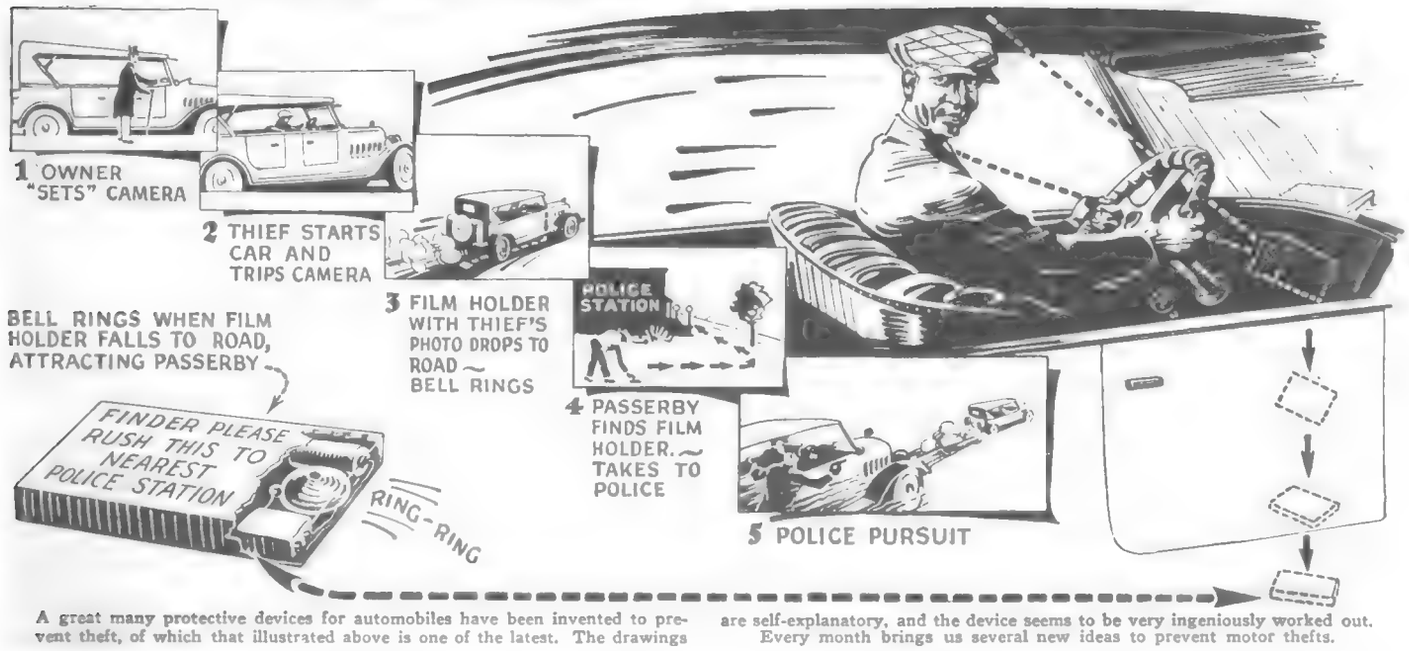
Above, the new pistol projects a steel pin through the skull into the brain of the animal, and is said to be entirely painless.

At the right, the crystals of ordinary copper are seen under a magnifying glass to be about the size of pin heads.

Largest Metal Crystal in Existence

Scientists in the General Electric Company laboratory succeeded in producing a single crystal of copper 17 inches long and 2⅜ inches in diameter, weighing 12 pounds. It has 12 per cent greater conductivity than ordinary copper. Fed from an electric furnace at the rate of ¼ inch per hour, it required 68 hours for completion. It can be easily bent out of shape, having about the consistency of putty, but a pressure of many thousands of pounds is required to return it to its original shape, due to the fact that it is no longer a single crystal when it has been distorted.

Automatic Camera to Foil Auto Thieves


1 OWNER "SETS" CAMERA
2 THIEF STARTS CAR AND TRIPS CAMERA
3 FILM HOLDER WITH THIEF'S PHOTO DROPS TO ROAD — BELL RINGS
BELL RINGS WHEN FILM HOLDER FALLS TO ROAD, ATTRACTING PASSERBY
FINDER PLEASE RUSH THIS TO NEAREST POLICE STATION
RING-RING
POLICE STATION
4 PASSERBY FINDS FILM HOLDER. — TAKES TO POLICE
5 POLICE PURSUIT

A great many protective devices for automobiles have been invented to prevent theft, of which that illustrated above is one of the latest. The drawings are self-explanatory, and the device seems to be very ingeniously worked out. Every month brings us several new ideas to prevent motor thefts.

How Cast Iron Radiators Are Made

By HENRY TOWNSEND

TO the city dweller as well as the suburbanite there is probably nothing more common than the ordinary steam or hot water radiator. Seldom, however, do people stop to think of the science behind the molding of the hollow cast iron units or sections comprising the radiator in their home or office. There are two general types of steam and hot water radiators made, including those employed for the vapor system of heating, these two classes of radiators comprising those molded of cast iron and those made from pressed steel. The pressed steel radiators are of course made by means of large dies which press or stamp out half sections from sheet steel of the proper thickness. We are particularly interested in the present case in the method of molding cast iron radiator sections.

HOW RADIATORS ARE MADE HOLLOW

Everyone not familiar with foundry work invariably ask as the first question,—"How do they get the hole inside of the radiator sections?" The hollow interior is created by means of a baked sand core. The accompanying illustration shows a typical scene in a radiator factory at pouring time which occurs about 3:00 o'clock in the afternoon daily. In the morning the molders are busy setting up their patterns and tamping the molding sand into them, so that the sand conforms to the exact shape of the pattern. This sand is of very fine quality and when tamped tightly into the flasks or iron containing-boxes, it retains the exact shape of the pattern after the pattern is carefully withdrawn.

HOW MOLDS ARE SET UP

The drawings at the bottom of this page show the principal steps in preparing the mold for a cast iron radiator section or unit. The two part iron flask resting on its wooden sub-base is shown at Fig. 2, the sand being tamped against the pattern first from one side and then from the other, the flask being reversed as the work progresses, by grasping the handles on the ends of the flask. The flask members are lined up

A radiator foundry is shown below. The molten iron is seen pouring out of the spout at the bottom of the furnace, while the motor-driven blower maintains a blast of air through a series of openings to the interior of the furnace. Successive layers of coke and iron comprise the charge of the furnace.

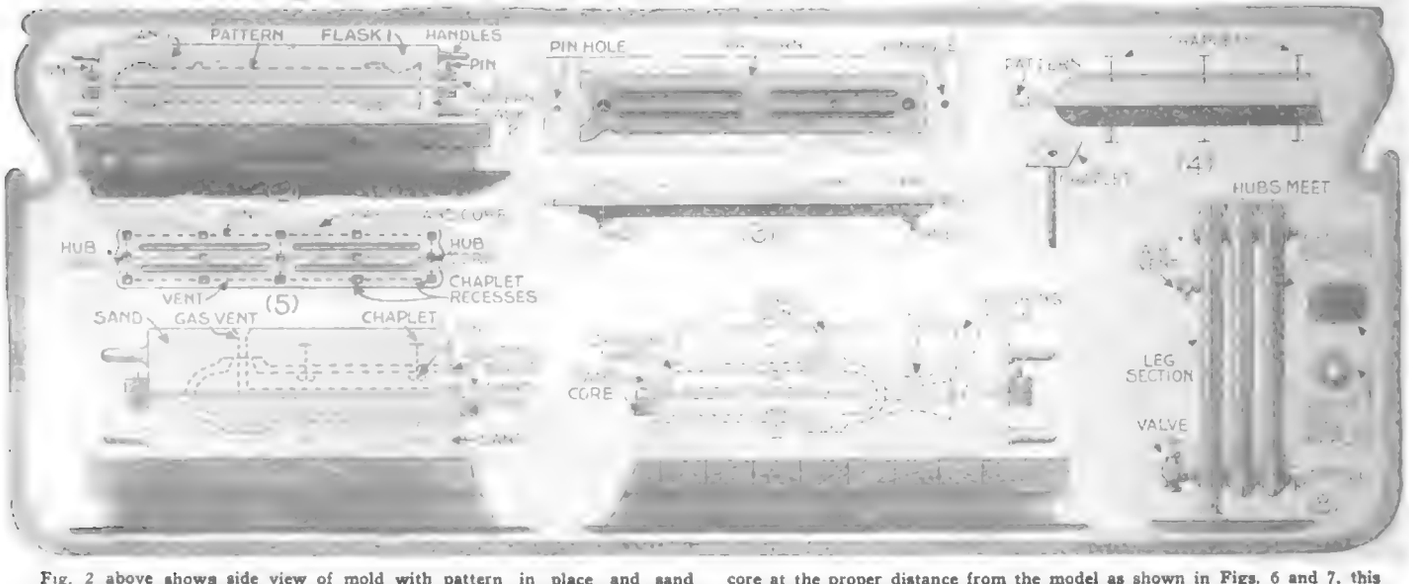
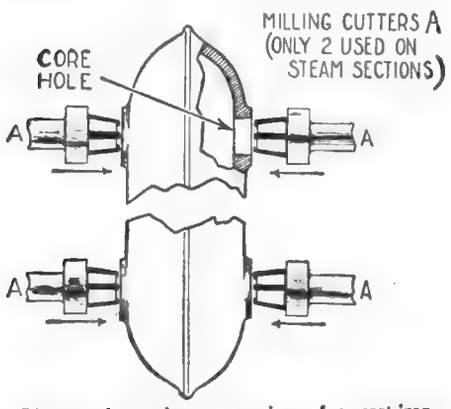


Fig. 2 above shows side view of mold with pattern in place and sand tamped to conform to pattern. Fig. 3 shows top and side view of pattern. Fig. 4 shows iron chaplets which support and hold baked sand core at the proper distance from the model as shown in Figs. 6 and 7, this core disintegrating after pouring. The core is made of sand tamped into a hollow mould called a core-box and baked before use.



Picture above shows top view of a cast-iron radiator section, having its four holes reamed out simultaneously by the milling cutters, A.

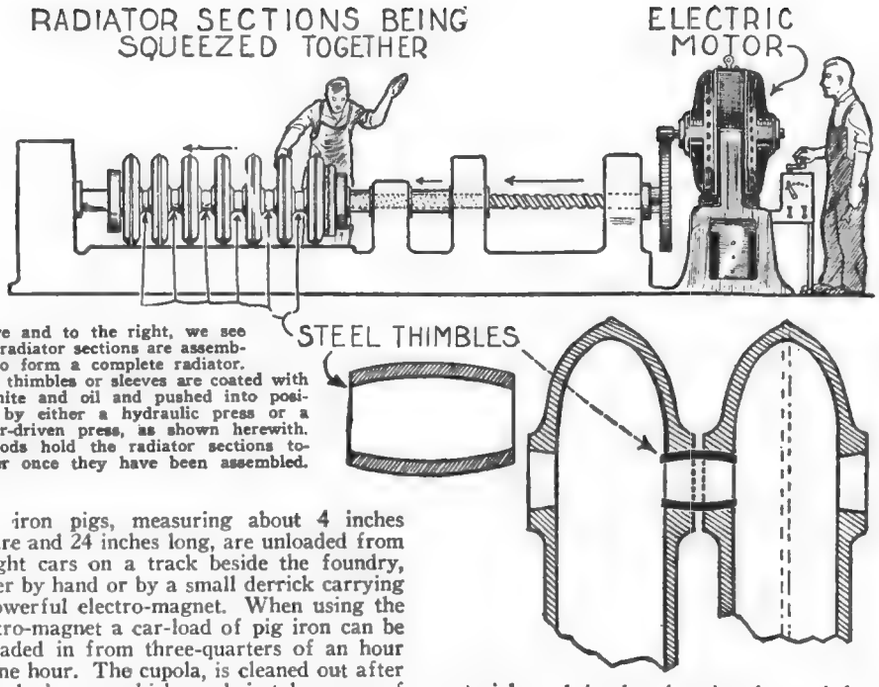
with the metal pattern by means of steel pins and pin holes provided at both ends as shown. The two-part flask has to be separated for the withdrawal of the pattern, as becomes apparent, and any parts of the sand impression made by the pattern which have become damaged are carefully repaired by the molder by means of small hand tools. As the drawings 6 and 7 show, gas vents are provided as well as a pouring hole. The baked sand core, the sand being mixed with molasses water or else with core oil before baking, is carefully placed inside the two-part flask after the pattern has been withdrawn by lifting off the top half of the flask, as illustrated in Fig. 2. The baked and hardened sand core, is held in position so as to leave a space all around it, the thickness of the radiator wall, about 3/16 inch, by means of what the molder calls *chaplets*. These resemble a small nail with a square metal head, and these chaplets are placed at first in small holes equally spaced over the pattern of the radiator section. As the sand is tamped in, these chaplets are held rigidly and when the pattern is lifted out by separating the flask, the ends of the chaplets, resembling a row of nails, are to be seen.

The ends of the chaplets press against pieces of tin which are placed in the recess provided on both sides of the sand core. This is all made clear by the drawings Figs. 6 and 7. Thus when the two halves of the mold or flask are placed together, they form a hollow space with the sand core in the center, and into this thin annular space corresponding to the shape of a radiator section, the molten iron is poured by the molder from a small ladle provided with a fire clay lining.

Fig. 8 of the drawing shows how the radiator sections, after they have been tested and the holes in the ends of each section machined down to proper size, are joined together by means of spring steel nipples. The radiator sections are pressed together as shown in the drawing on the opposite page by means of a powerful hydraulic or else a motor-driven press.

CHARGING THE CUPOLA

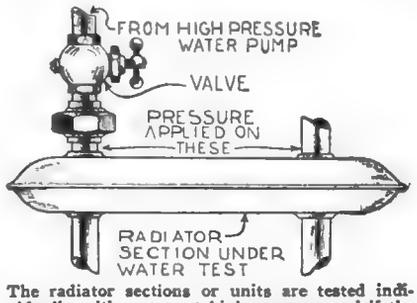
The loading or charging of the cupola, which is a small blast or shaft furnace, in which the pig iron is melted each day is always very interesting to those who have not had much acquaintance with foundry work.



Above and to the right, we see how radiator sections are assembled to form a complete radiator. Steel thimbles or sleeves are coated with graphite and oil and pushed into position by either a hydraulic press or a motor-driven press, as shown herewith. Tie-rods hold the radiator sections together once they have been assembled.

The iron pigs, measuring about 4 inches square and 24 inches long, are unloaded from freight cars on a track beside the foundry, either by hand or by a small derrick carrying a powerful electro-magnet. When using the electro-magnet a car-load of pig iron can be unloaded in from three-quarters of an hour to one hour. The cupola, is cleaned out after each day's run, which work is taken care of by the night force. The bottom of the cupola furnace is hinged and can be dropped so as to thoroughly clean out the slag and any remaining unmelted pig iron or unburned coke. The cupola is usually filled up with successive layers of coke and pig iron at night and during the next morning. First of all the floor of the furnace hearth is covered with sand, then comes paper and a cord or two of wood, depending upon the size of the furnace.

On top of the wood is dumped a ton or so



The radiator sections or units are teated individually with water, at high pressure and if the cast-iron wall is too thin, it will break under the pressure; weak spots also show up as well as cracks.

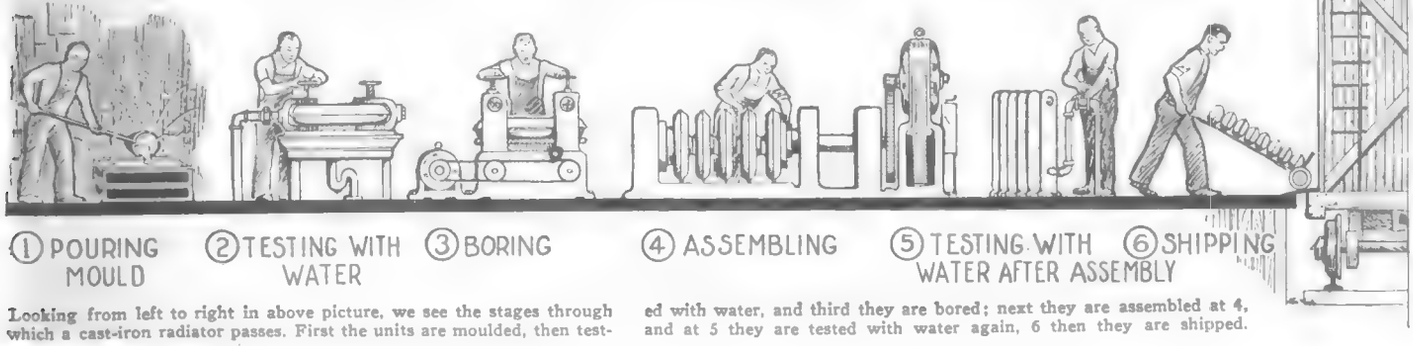
of anthracite coal, and then come successive layers of coke and pig iron. About noon of any working day, the furnace is started, a forced draught of air from a large motor-driven blower being fed into the fire-box of the cupola through a series of openings or pipes known as tuyeres. The air from the blower travels all around the firebox in an annular chamber, as the illustration herewith shows, and the air passes from this annular chamber, through the series of tuyeres into the firebox proper. The charges of coke and pig iron, etc., are fed into the furnace through the charging door on the second floor. The material used in the charging is carried to this second floor by means of an elevator or else by an endless conveyor.

The inside of the furnace is lined with fire-brick. The amount of molten iron in the bottom of the furnace at any time, once the iron begins to melt, is never more than a few inches deep. At the start the spout hole on the front of the furnace is plugged up with a piece of fire-clay. Slag holes are provided around the base of the furnace, through which the cupola men may run off any slag or foreign material floating on the surface of the iron, by ramming an iron bar through the slag holes. In most cases to-day electric pyrometers or temperature indicators are used to show the temperature inside the furnace at all times. This temperature is in the neighborhood of 2,000 degrees Fahrenheit.

Some clearing agent has to be utilized to clear the slag from the metal, and accordingly limestone in pieces the size of an egg, interspersed through the charging load of the furnace, is the substance in common use. Oyster shells are excellent for clearing away slag and in Maryland, where they are common, the larger smelting cupolas use them entirely in place of the broken limestone.

The proportions of scrap and pig iron used for the daily charge is very important, because with an improper percentage of scrap or undesirable scrap the castings may contain hard spots which will play all kinds of havoc with the special boring mills through which they must pass later on. Generally the proper load or charge of iron for a day's heat is arranged definitely by weight, the cupola-tender keeping tally of the succeeding weights of iron placed in the furnace. In charging the cupola alternating layers of coke and iron are placed in it until the full load or nearly so is in it, which reaches up to the charging door on second floor.

(*Continued on page* 834)



Looking from left to right in above picture, we see the stages through which a cast-iron radiator passes. First the units are moulded, then tested with water, and third they are bored; next they are assembled at 4, and at 5 they are tested with water again, 6 then they are shipped.

Transmitting Pictures by Wire and Radio

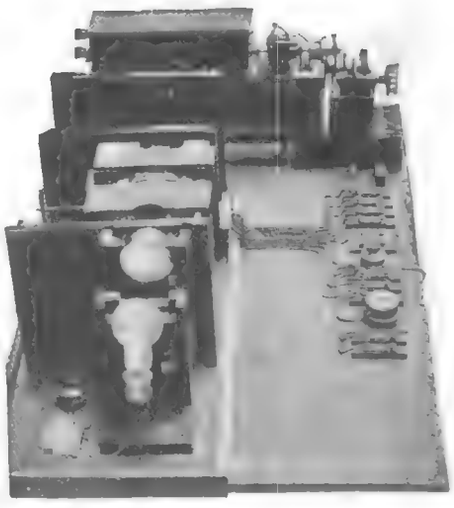
The New Photo-telautographic Achievement of Berthold Freund

Written by the Inventor

THE first development of picture telegraphy dates from the middle of the nineteenth century employing the then well-known metallic telegraph circuit. If one ruled upon a piece of paper containing hand-writing, printing or engraving, two parallel lines close together, so that they projected a very small amount above the surface, there would result a succession of longer or shorter black lines or points with longer or shorter white intervals between them somewhat similar to an ordinary Morse code.

At the left is a photo of the transmitting apparatus used in sending pictures over wire or radio by the new process called photo-telautography.

The receiving set shown at the right is similar in many respects to the standard radio sets used in receiving programs broadcast for entertainment.



If now instead of a sheet of paper an electrically conductive metallic foil is used, and the writing is done upon the same with insulating ink, the small picture elements described above, can be brought into the circuit by a metallic finger or pencil. Thus if one lets the metallic pencil, with perfectly even speed, move along the picture element, which for shortness we will call a "trace" or "picture trace," and if the metal foil is connected to one pole and the metal point to the other pole of an electric circuit, the metallic pencil will close the circuit when it is over the "white," that is to say blank portions of the trace, and will open the circuit when it rests upon a "black" portion; that is to say, on the traces covered with insulating ink.

If the current intervals thus obtained are sent over telegraph wires to receiving stations, and if they act there on a receiving apparatus which consists of a sheet of paper moving with constant speed, the current impulses will be indicated by corresponding long streaks and points, which will give us a perfect reproduction, and a negative one, of the picture traces from the sending station. As we now put together all the numerous closely distributed picture-traces exactly as they were originally produced and bring all the reproductions of the picture traces together at the receiving station, we have an exact reproduction of the whole picture.

The photograph above shows the appearance of an image which has been transmitted by the new system. It will be noted that there is practically no distortion visible.

In practice this work is carried out usually so that the picture foil with the picture to be sent out is wrapped around a cylinder which shifts along in perfectly even motion. A metal point similar to a phonograph needle, passes over the rotating cylinder and in this way moves over the whole surface of the said cylinder in what is practically the course of a screw of fine pitch. At the receiving station there is a second cylinder with precisely equal speed of rotation and of corresponding phase, and, therefore, synchronously rotating, and on which a sheet of photographically sensitized paper for the reception is secured. The writing point, in this case a very thin beam of light, moves along this cylinder exactly as the metallic point of the sending station moves. In consequence of this, the traces which come in are reproduced in a helical line in exactly the sequence in which they were produced at the sending station, and we thus obtain at the receiving station an exact reproduction of the picture to be transmitted.

The principle here described of picture telegraphy which works at the transmitting station with a contact point, indicates the method of the so-called copying telegraphy or Telautograph, as it was carried out for the first time in the year 1847 by Bakwell and in the period 1902 to 1906 by Prof. Korn, who improved materially the photographic registry at the receiving station. It is clear that with the help of this contact method any "black and white" picture, as for example a sketch, an autograph, print or photograph, transferred to the metal foil can be sent over the line, but the exclusive restriction to "black and white" pictures or line pictures, is a great disadvantage of this method which in practical applications of picture telegraphy often cuts out the transmission of pictures in tone, and this point is of considerable importance. And it is also a disadvantage that in this method the production of a picture on metallic foil must precede the transmission thereof.

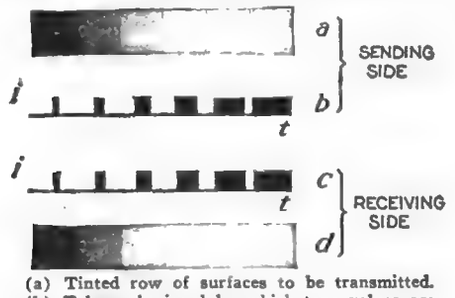
It will therefore be a real advance if tone pictures with all variations in shade, for example, photographs, could be sent directly by picture telegraphy, and this is done by using the selenium cell.

The peculiarity of selenium of changing its electric resistance, according to whether it is in the dark or in the light, was discovered in the year 1873 by Smith. It is found that the electric resistance of selenium is approximately proportional to the strength of light to which it is exposed. If one, therefore, places between the poles of a battery, and attached to the electrode, a layer of properly prepared selenium, and exposes this selenium to a changing degree of illumination, the strength of the battery current passing through the layer will change constantly as the light changes in intensity. This simple arrangement entitled, "The Selenium Cell," will now be appealed to for the realization of the problem of the electric transmission of tone pictures such as photographs.

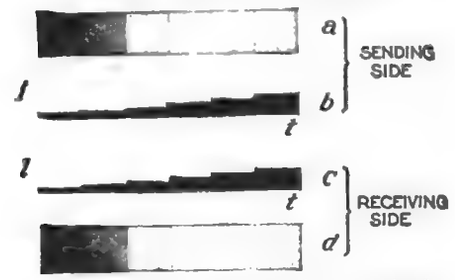
Already in the year 1877 Senlecque published a desription of an electrically operating television apparatus with a selenium cell. In the year 1881 Bidwell succeeded with the help of a selenium cell, in carrying out the reproduction at a distance for the first time

A high magnification of a small area on one of the received photographs shows a smoothness of texture hitherto unattainable with commercial processes of photo-transmission. The high-lights and shadows are brought out in perfect detail, the artistic effect suffering not at all.

of a tone photograph, and in the period 1902 to 1906 Prof. Korn improved the operation materially, among other things by effecting the production photographically of the picture at the receiving station. The principle of this "selenium method" or direct "phototelegraphic" method is the following: If on a photographic plate which may be a



(a) Tinted row of surfaces to be transmitted. (b) Telegraph signal by which tone values are indicated. (c) Received impulses. (d) Reproduced tone picture at receiver.

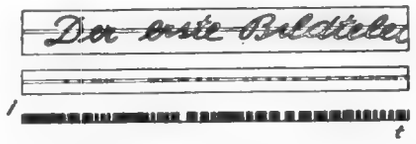


(a) Graduated tone-points to be transmitted. (b) Varying photo-electric current transmitting the tone values. (c) The varying current at the receiving station. (d) The tone values reproduced as received.

negative, just as formerly spoken of in copying telegraphy, we produce two parallel straight lines lying close together, these picture traces will consist of a continuous series without a gap of surfaces of various depths of shade. Now if instead of the metallic point of the copying telegraph, a ray of light extremely thin and converging, is caused to move over the photographic layer and if this light ray after passing through the plate falls upon a selenium cell placed behind the plate then on account of the varying transparency of the successive portions of the picture-trace the light falling on the selenium cell will be changed in its intensity without being cut off. These changes in the illumination of the selenium cell varying with the tone value of the picture traces bring about corresponding changes in the resistance of the selenium cell, and consequently corresponding changes in the intensity of the electric current flowing through the cell. The variable current intensity thus obtained gives a measure of the successive parts of the picture in regard to their brightness referring to the picture traces. This "photoelectric" current of changing intensity is carried to the receiving station and affects here a source of light, for instance by the motion of the little plate of the suspension galvanometer, which in normal position cuts off the ray of light, and then lets more and more light pass according to the degrees through which it is turned by the incoming current. By the light ray thus allowed to pass, a still finer point of light is caused to fall upon a photographically sensitized layer moved with synchronic speed, all being done by optical projection, and this leaves upon the traversing layer a thin line varying in tone which reproduces the lighter or darker portion as the amount of light is expressed or affected by the photo-electric incoming current. This photographically obtained line of varying tone expresses precisely the picture traces of the photographic plate at the sending station. And now as we in repetition of the described process by means of light rays and the selenium cell obtained at the sending station all the closely located picture traces optically, that is to say photoelectrically, and as the receiving station produces the original picture traces expressed in a similar way and close together in rows, we get the reproduction of the tone pictures to be transmitted with all the delicacies of shadow and shade.

In the practical application of this selenium apparatus, exactly as in the telegraphic copying process, the picture as it may be lies upon synchronously rotating cylinders in the form of photographic films, both at the transmitting and receiving stations, and are obtained in the narrow helical tracings as described.

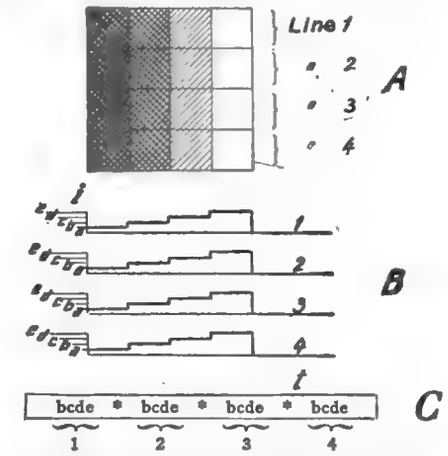
The two methods of picture telegraphy, the Telautographic, and the direct phototelegraphic methods, previous to the World War occupied the field of work. Here they were concerned almost entirely with transmitting pictures over telephone and telegraph wires, but during the war and especially after the war, wireless telegraphy came into great prominence, as also did wireless telephony, which brought the wireless transmission of pictures more and more into prominence. This was required in the course of the war, especially for military needs, and after the war by the all-important standing which wireless telegraphy obtained for the great Trans-Atlantic news service. One experimented therefore, naturally with both methods of picture transmission, the Telautographic and the direct phototelegraphic, with the idea of carrying out the transmission by wireless, when the telegraphic impulses or the photoelectric current was employed for regulating the transmission energy of the radio station. Even during the war, Professors Korn, Dieckmann and others, carried out experiments with the wireless transmission of pictures on teleautographic and telegraphic copy methods, and they succeeded in producing good wireless transmission of sketches at a short distance, but various difficulties sprang up in these methods, principally in exceedingly great uncertainty of success which with increasing distance always grew greater. These difficulties directly after the war forced these picture telegraphic methods into the background, and in their place a third method of picture transmission was developed, which in its essentials had already been long known, but had practically been hardly used. This was a so-called intermediate "mat" or "cliché" method. This method is based on the use of a variable photo-electric current from a selenium apparatus. This is not



An illustration of how a simple design is transmitted. (a) One of the "picture lines" of the design to be transmitted. (b) The black and white dots of the "picture lines." (c) Represents the transmitted current of the "picture line."

employed directly for guiding the production of the picture traces at the transmitting station. By means of this current, a sort of half tone reproduction of the light value of all points of the picture is obtained in a form adapted for telegraphic transmission. This intermediate form thus produced constitutes the so-called "intermediate cliché."

It was Prof. Korn, who in the year 1922, with his intermediate cliché apparatus, carried out the first indirect transmission from Europe to America. In his apparatus the intermediate cliché consists of a long typographic telegram tape that is thus produced. The varying photo-electric current of the selenium apparatus is connected to an automatic arrangement, in which for each current intensity step, a particular letter of the alphabet is assigned and is registered. Each photo-electric current intensity corresponding to a point on the picture, registers a letter corresponding to one of the light values of the points of the picture. The ten thousand letters or more expressing the many picture-points are produced on a long telegraphic tape, the so-called intermediate cliché in the form of an ordinary printed telegram. The wireless production of this printed telegram can be done by hand or by rapid teleg-



The principle of the "intermediate electro-method." (A) Surface tinted by points including 16 areas. (B) The current from a selenium cell corresponding to the four lines of the surface, (A). (C) The "intermediate electro" given out by the selenium apparatus representing the tinted surface, A.

raphy in regular telegraphic transmission. At the receiving station the incoming letter-telegram is written down accurately and then with the help of an arrangement like a typewriting machine, a point of special size corresponding to each letter, is impressed so that the picture is brought out as a series of points. This form of indirect transmission with intermediate cliché requires no synchronism. The translation of the picture to a telegram can be done at any desired time, as also can the production of the picture at the receiving station end. By these methods therefore no disturbance of the telegraphic functions takes place. After similar indirect intermediate electro methods somewhat later in 1923, the Radio Corporation of America carried out the transmission of pictures between America and Europe, while at a more recent time frequent wireless transmission of pictures both in the direct phototelegraphic methods (1924, Jenkins in America), as also in the black-white method (1924 Marconi, London), the latter between Europe and America was successfully carried out. The above described three methods of picture telegraphy incorporate the present points of view, in accordance with which picture transmitting apparatus have hitherto been constructed.

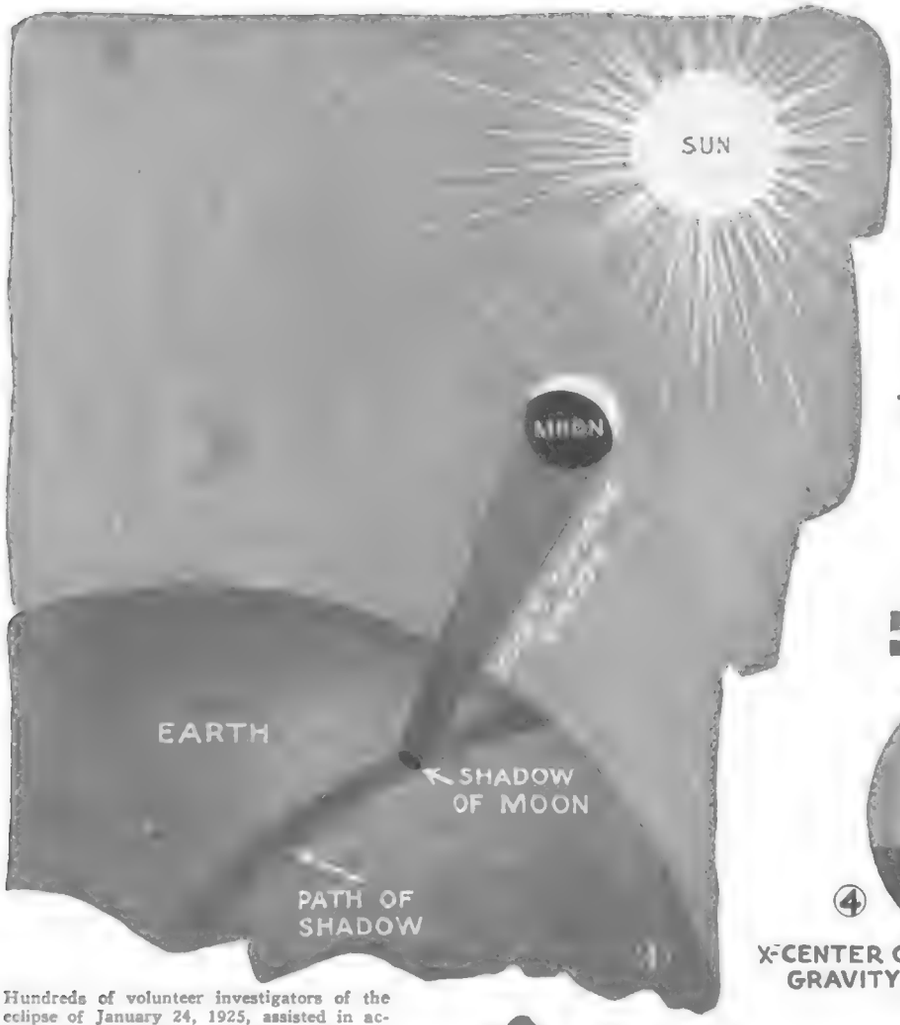
But now each of these methods practically solve only a particular problem of picture transmission. Thus for example, the Telautograph makes possible a direct picture transmission by the use of telegraphic signals, and is now in condition to cover the entire transmitting area of a broadcasting station. On the other hand, it only transmits black and white or line pictures, and cannot send any tone pictures such as photographs directly. It requires for such purposes a preliminary preparation of a metal foil replica. On the other hand the direct telephotography which is carried out by use of a selenium cell or of any one of various other photo-electric tubes, presents the advantage that it needs no metallic foils or special replicas, and can send out tone pictures with the greatest delicacy of shade, directly produced, and repeated with true photographic quality. It possesses, however, the disadvantage that the

(*Continued on page* 832)

The Shape of the Moon

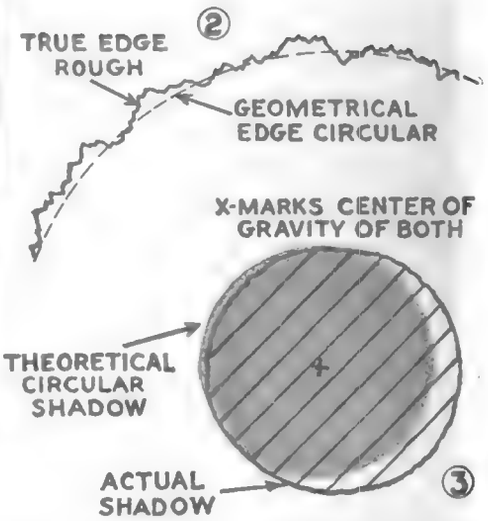
The Latest Theories Prove It To Be Lop-Sided

By DONALD H. MENZEL, Ph. D.
Lick Observatory, Mt. Hamilton, Calif.

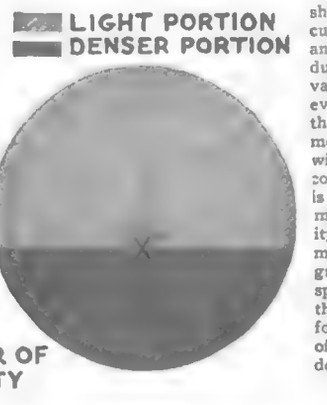


Hundreds of volunteer investigators of the eclipse of January 24, 1925, assisted in accurately determining the northern and southern shadow limits; thus lopsided moon theory was developed.

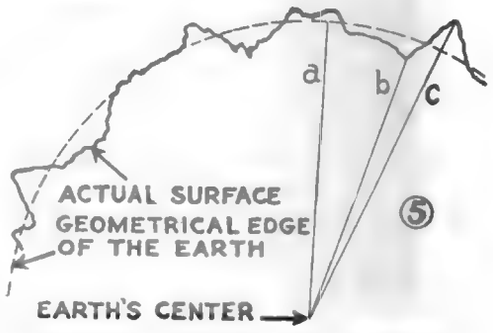
The average density of the crust underlying mountains, B, is less than the average density of the parts of the earth underlying oceans at A. It is this force that causes the moon to be lop-sided.



The edge of the moon, as shown in 2, is not a true curve, but rather a jagged and ragged edge. This is due to the mountains and valleys upon the disc. In even the face of this fact, the real shadow of the moon did not coincide with the predicted or computed shadow. This is shown in 3, where X marks the center of gravity of both figures. Inasmuch as the center of gravity of the theoretical sphere must coincide with that of the actual body, it follows that the top part of the moon, 4, is less dense than the lower half.



The tendency of a body to balance itself is well known, and in this respect the moon is not unlike the earth. The theory of isostasy states that along any radius drawn from the earth's center to the surface, the actual quantity of matter is the same, whether along the lines a, b, or c.



The amount of deformity is greatly exaggerated in the diagram and in actual observations it is too small to be detected by telescopic observations.

At a recent meeting of the American Philosophical Society, the oldest scientific society in America, organized by Benjamin Franklin two hundreds years ago, Professor Ernest W. Brown of Yale University presented the result of an interesting investigation concerning the shape of the moon. Professor Brown is an authority on the moon and its motions and his theories will have great weight with the astronomers. He concludes that the moon is not exactly round but a trifle lop-sided.

This interesting result was reached from a study of the observations of hundreds of amateur and professional astronomers during the total eclipse of the sun which occurred January 24, 1925, visible in New York City. Such an occurrence offers an excellent opportunity to study the problem of the shape of the moon, for at that time its shadow is cast upon the surface of the earth as shown in Fig. 1. The shadow is, of course, not stationary, but moves in the direction of the arrow. The task of the investigators of the eclipse was to determine as accurately as possible the northern and southern limits of this shadow.

The edge of the moon is, naturally, not a true curve, but jagged and ragged, owing to the mountains and valleys upon the disk. (Fig. 2). After discounting the observations for this expected fact, the shadow still did not fall upon the spots predicted, but systematically came too late at certain places and too early at others. The difference between the computed and observed shadows is shown in (Fig. 3.) It is seen that the moon's shadow and therefore the moon itself is not round as will be seen.

The laws of celestial mechanics or motions of the heavenly bodies require that the center of gravity of the moon, no matter what its shape, coincide with the center of gravity of the theoretical sphere. The consequences are plainly demonstrated in (Fig. 4). If the cross marks the center of gravity, it is obvious that the top part must, on the whole, be less dense than the lower half. In other words, the bulk at the top compensates the greater weight in the bottom.

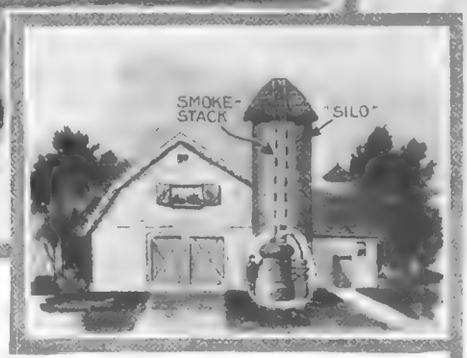
This tendency of a body to balance itself is well-known, and the case for the moon is not unlike that of the earth. This is called the theory of isostasy. In brief it states that along any radius drawn from the earth's center to the surface (see Fig. 5) the

(*Continued on page* 858)

The Month's Scientific News Illustrated

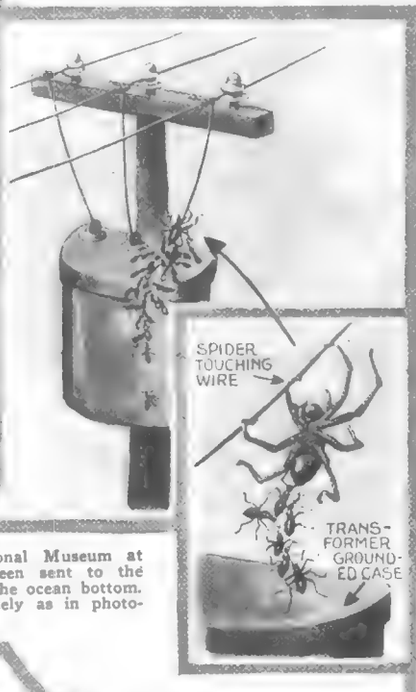
By GEO. WALL

Although it is not expected that any great change in ordnance design will come as a result of his experiments, the experts of several countries have watched with interest the development of large caliber compressed air rifles by a Berlin locksmith Herman Plieth. Three millimeters, about ⅛th inch, of steel were punctured at 2000 meters range.



Every day new stunts are tried by bootleggers and home distillers to evade the watchful eye of Uncle Sam's revenue agents. The latest appears in a still discovered in a silo at Woodbridge, N. J. A few days ago two 500 gallon stills for redistilling denatured alcohol were found concealed by the effective camouflage shown above.

Babe Ruth, the favorite child of Baseball, added to his laurels the other day at Mitchel Field, L.I., when he succeeded in catching a baseball dropped 250 feet from an airplane traveling over 100 miles an hour. Due to the erratic path of the balls, he was able to catch only one out of seven.



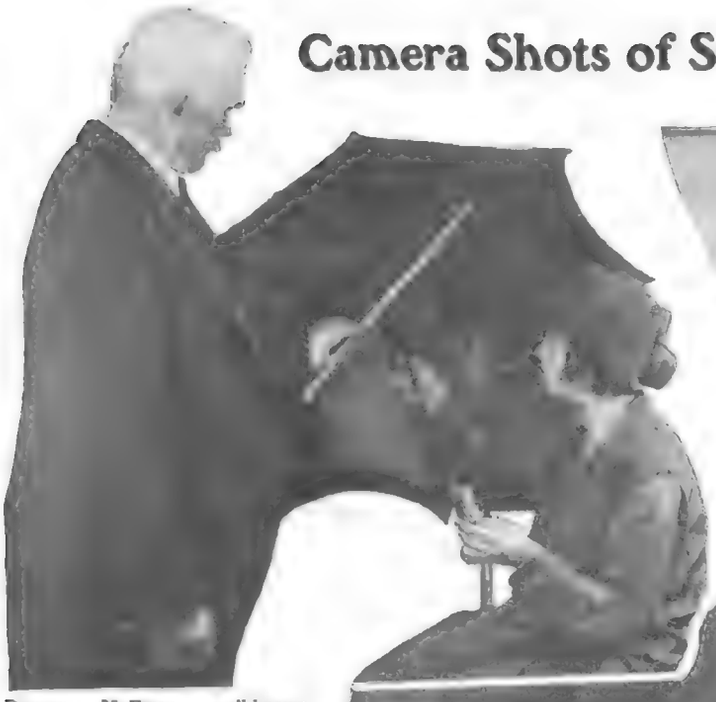
Dr. Paul Bartsch, curator of mollusks of the National Museum at Washington, who originated undersea movies, has been sent to the island of Tortugas to operate a new movie camera on the ocean bottom. He hopes to record subsea life as simply and accurately as in photographing on dry land.

A Miami judge David J. Heffeman, of the Night Municipal Court tests the arguments of defendants before him by causing them to re-enact the conditions of traffic law violations with toy automobiles in his court-room.

Bridgeport, Conn., was recently the scene of a tragedy of the insect world which caused the dimming of light in the greater part of the residential section in that city. A large spider, it was found, had incautiously stepped from one exposed service wire to another. His electrocuted body was discovered by an industrious ant who led his fellows from an adjacent sandhill to feast upon the corpse. Hundreds of ants came up to the dead spider and were in turn electrocuted as they touched the body. The accumulated bodies of the insects caused a short circuit which dimmed the lights.

Devotees of water sports at British beaches this summer enjoyed the use of a cleverly devised aquaplane which is illustrated above. A frame, made of aluminum tubing, is supportd upon the surface of the water by means of three large inflated bladders. The frame is extended upward to [illegible] to be stretched upon it and to af[illegible]

Camera Shots of Science



Duncan McEwan, well-known Glasgow astronomer, has invented a novel umbrella which does everything but sing. The interior is a map of the heavens and around the edges it is marked off in days. By pointing the Pole star of the diagram (where the handle meets the center of the cover) toward the real Pole star in the sky, you can find your directions with ease.

Herr Lutsch, an Austrian, has invented a machine which is strapped to the back and is capable of allowing a man to fly in the air. The machine was tested recently and carried the inventor to a height of 150 feet and for a distance of 1-3 of a mile. The wings close and open like an umbrella and act exactly as a bird's wings. The spiral propellers revolve rapidly and are capable of lifting the man and the machine off the ground. They are then used to vary the height and to land. The mechanism of the machine is not available but the idea on its face is interesting.

Jacob Alstrom, a bachelor and inventor of Onset, Mass., has made the wall of his house so that he can let it down and sweep and air the rooms at the same time. Nothing like taking life easy, especially when one has to do his own housework. This photo shows Jacob Alstrom sweeping one of the rooms equipped with a convenient detachable wall. The Japanese have long used a style of home architecture which is reminiscent of this gentleman's idea, with the result that they have by far the cleanest and most sanitary homes of any nation. We will not attempt to certify as to the warmth of this type of construction when the thermometer begins to freeze up, but the owner in this photo looks healthy enough to satisfy any one's apprehension.

Where the scenario requires that a large number of players be "browned" to a Polynesian tint, the airbrush familiar to artists comes to the aid of the make-up expert. Myrna Loy, a well known Warner Bros. supporting player, was required to be made up as a half-caste.

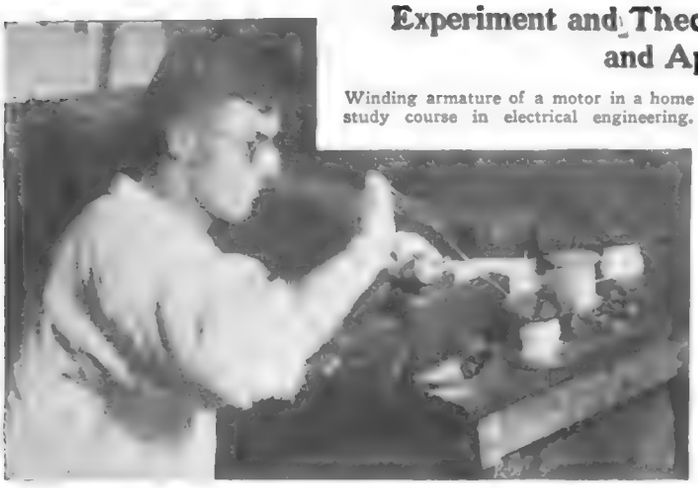
White leather backs and tan cape palms to the new "safety-first" gloves help motorists by rendering signalling more conspicuous to following drivers.

The sensation of the 20th annual automobile show in Paris was this tiny five horse-power, two-cylinder, two-cycle motor with no clutch or gears. To put the automobile in motion, it is only necessary to start the motor and press the accelerator, the connection between the motor and the wheels being made gradually through a system of governors actuated by centrifugal force. M. Constantinesco, the inventor, is also the perfector of the method, much used in the world war, of synchronizing a machine gun to fire through an airplane propeller.

A wooden block cut through with curves so that it grips a steel wire is the latest life-saving fire escape. The wire is suspended from its upper end and the pressure, regulated by a thumb screw, controls the speed at which the user may descend the wire in a safety belt. The photos show Mr. Wenneberg, the inventor, demonstrating his device.

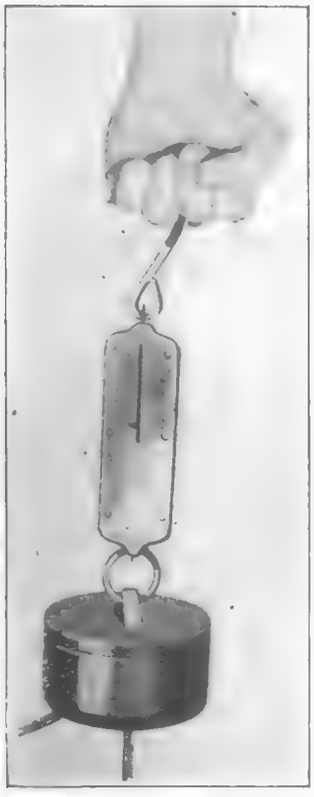
Engineering by Home Study

Experiment and Theory Taught by Course and Apparatus



Winding armature of a motor in a home study course in electrical engineering.

Placing the winding in a case to form a very powerful electro-magnet.



By means of a spring balance the pull of the electro-magnet provided with the study course, is obtained.

RESIDENT courses in electrical engineering have arrived at such a point that it is now possible for the student to receive real practical training by even the correspondence school course method. Instructors in electrical engineering as well as in various other subjects have found that it is almost impossible to teach the student properly by books. Experimental apparatus is absolutely necessary. The pupil must learn how to wind an armature for a motor, not alone by mentally following the instructions given in books, but by actually placing the wire on the iron laminations. He must know how to test this winding out for a *ground* or a *short-circuit*.

Experimental apparatus enables the pupil to do the work which will be required of him when he gets out into the field and meets his co-workers. Aside from the practical advantage which the use of apparatus will give a student, there is another decided aid in that a lesson once learned, by practical experimentation, is more easily remembered. The school giving this home-study course also gives resident study for B.S. and E.E. degrees.

Measuring the electro-thermal efficiency of a stove.

When operated on current from four dry cells, the electro-magnet easily sustains the weight of the girl as this photo shows.

This photograph shows the parts of an electric motor layed out on the table and the student following instructions for the assembly of the finished motor.

THOSE unable to complete a resident course in electrical engineering at a recognized college, can obtain a degree in some of the correspondence schools, a few of which supply the student with a myriad of materials. The photographs on this page show but a few of the various appurtenances with which the student is supplied when he enrolls for the modern type of correspondence school course. He is shown how to build an electro-magnet after having designed it; how to test his design; how to completely wind a motor, test it and make it operate; and how to measure the fractional horse-power which the motor will develop.

Photos courtesy School of Engineering of Milwaukee.

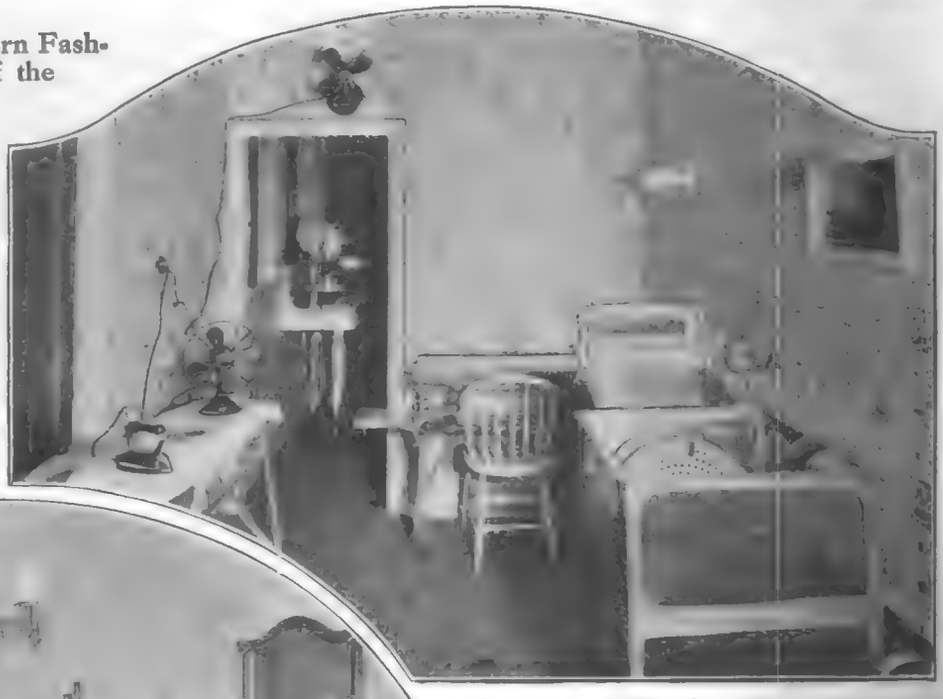
Measuring resistances by the use of a voltmeter and ammeter.

IT is of course necessary in the study of electrical engineering, that the course begin with the very simplest object namely, the making of electrical batteries of all kinds and it terminates not only with the design of alternating current sub-stations and their equipment, but takes into consideration the other various associated subjects, of hydraulics, mathematics, calculus, chemistry, commercial law, engineering law and illuminating engineering. A modern course in electrical engineering must include radio. This course must be complete not only from the standpoint of building radio receiving sets, but installing a complete radiophone transmitter. After the student has obtained an E.E. degree, he is fitted to enter any branch of the electrical industry and its numerous ramifications.

The Home Scientific

In Order to Equip A Home In Modern Fashion One Must Keep Abreast of the New Things For the Home.

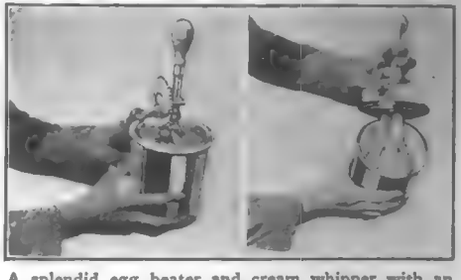
The photograph above shows a collapsible coat hanger which may be folded into a case to fit a man's vest pocket or milady's purse—R. G. Thackwell.



Above: The laundry of a modern electrical house with flat iron, ironer, washing machine and wringer.

The photo at the right shows an ideally equipped dining room provided with toaster, table stove, waffle iron, fan, percolators and lamps.

The photos of the "Electric Home" were taken at the Philadelphia Sesquicentennial Exposition.



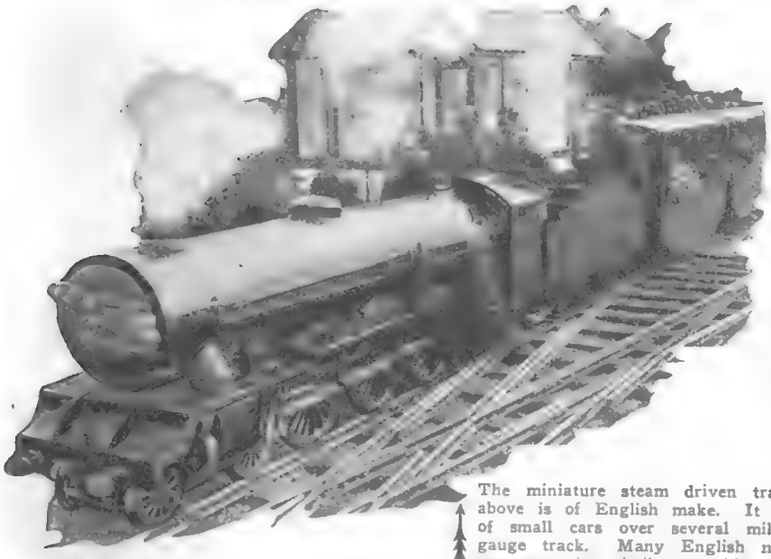
A splendid egg beater and cream whipper with an unspatterable cover, operated by hand.—A. P. Child.

A small washing machine which will take one bed sheet or the baby's wash is illustrated above. This machine operates at variable speeds and is incidentally ideal for silk lingerie.—Eden Washer Corp.

Right: A modern electrically equipped kitchen with electric refrigerator, fireless cooker, electric range and other electrical devices. ➤➤➤

"Electric Home" Photos courtesy General Electric Co.

Miniature Train De Luxe

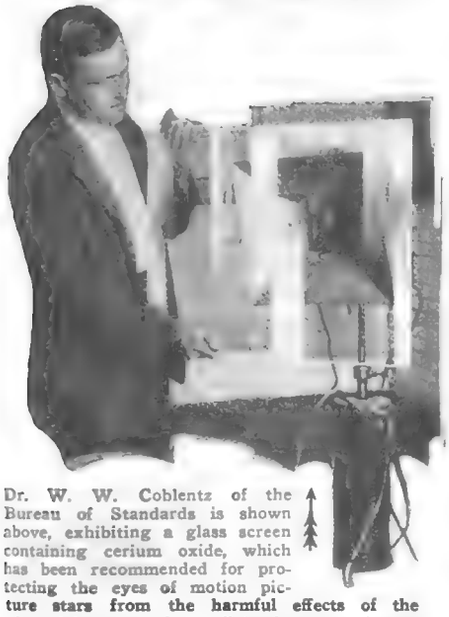


The miniature steam driven train illustrated above is of English make. It hauls a train of small cars over several miles of special gauge track. Many English model builders possess trains similar to this one, in which they take special pride. We hope to see this practical hobby spread in our country. The idea is worthy of emulation, both for the pleasure and training obtained by the builder. We expect to hear from some American genius who has built such a miniature railway, but electrified!

Diseases Treated Through Lungs

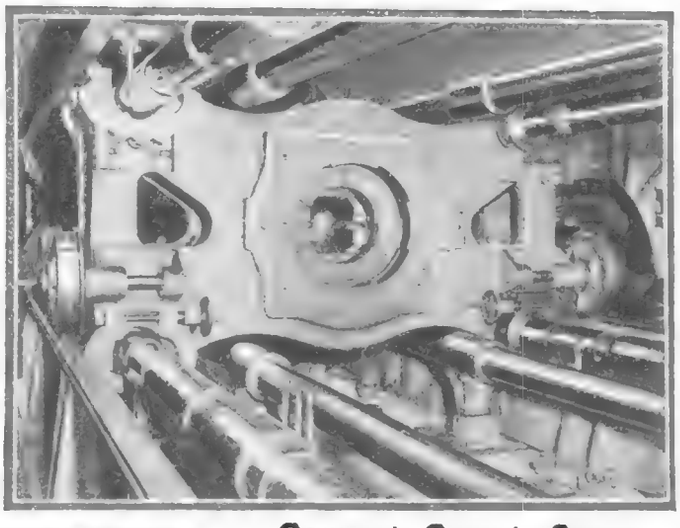
Octavio Felix Pedroso, a young Brazilian doctor, during experiments on the possibility of preventing the coagulation of blood, discovered the "Vitameter" by which he claims he can detect and cure any disease by treating the lungs. Maybe!

Eliminating Kleig Eyes



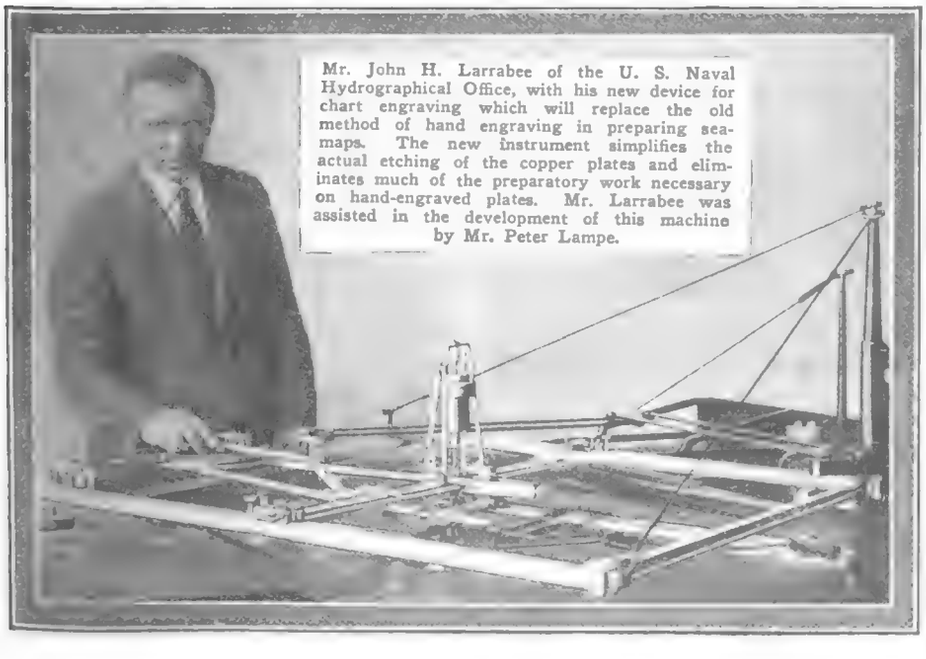
Dr. W. W. Coblentz of the Bureau of Standards is shown above, exhibiting a glass screen containing cerium oxide, which has been recommended for protecting the eyes of motion picture stars from the harmful effects of the ultra-violet rays given off by large arc lamps.

World's Largest Testing Machine



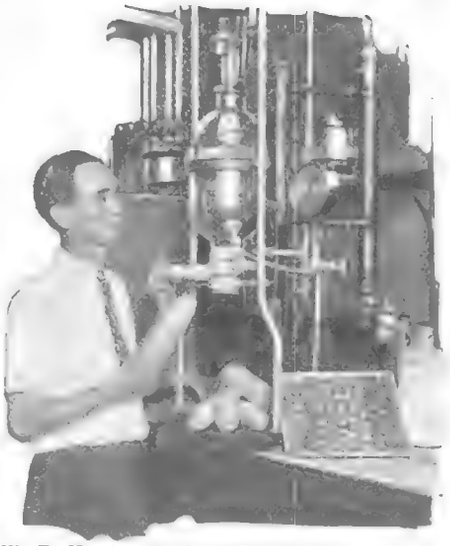
The 1,250-ton testing machine, shown at the right, which has been constructed at Birmingham, England for a firm of English bridge builders, is the largest of the "universal" types in the world. An idea of its size and power may be obtained from the knowledge that compression members 50 feet long and 45 feet wide may be tested to destruction. Its first work will be in experiments in connection with the construction of the Sidney, N. S. W., Harbor Bridge, where the steel work will be subjected to a complete series of tests with this giant machine.

Nautical Charts Now Machine Engraved



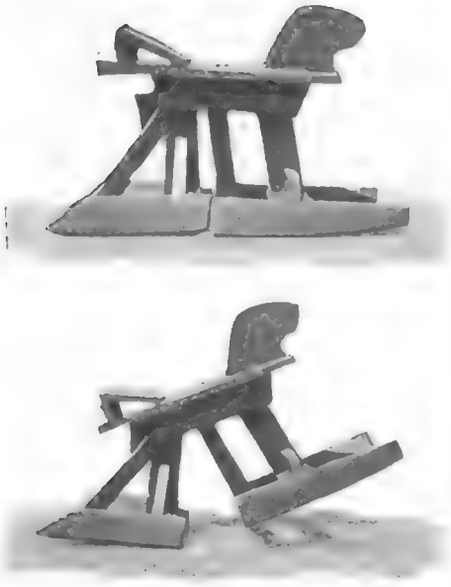
Mr. John H. Larrabee of the U. S. Naval Hydrographical Office, with his new device for chart engraving which will replace the old method of hand engraving in preparing seamaps. The new instrument simplifies the actual etching of the copper plates and eliminates much of the preparatory work necessary on hand-engraved plates. Mr. Larrabee was assisted in the development of this machine by Mr. Peter Lampe.

Converts Corn to Sugar



W. F. Hernberger of the Department of Agriculture, with his new device for converting corn into sugar, 95% as sweet as cane sugar.

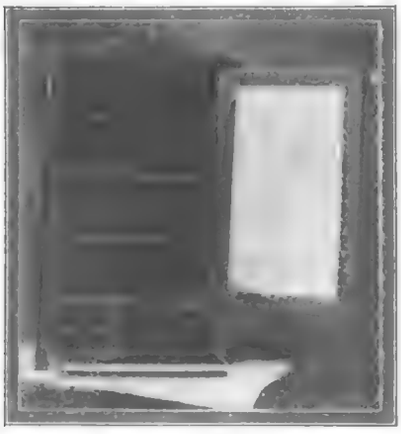
Further "Board"

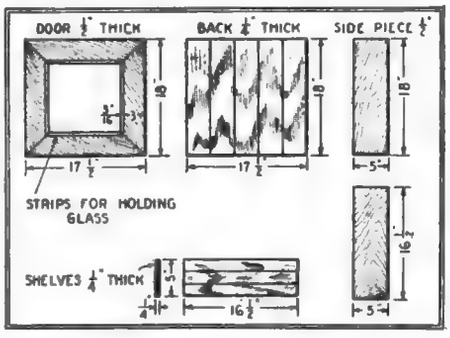


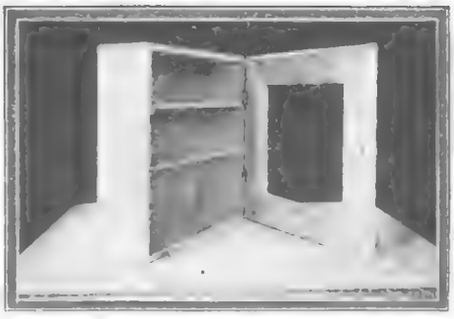
The galloping horse illustrated in these four views was made of the board specified in the $300.00 Board Contest which permitted the use of a piece of wood, 4 feet long, 1 foot wide and 1 inch thick. The device was made by John D. Dengler, of Pittsburgh, Pa., and the successive stages of its movement are here indicated. When the horse is standing still, it assumes the position shown at the top of this column. As the child rocks back, into the position indicated by the lower photograph, the front legs of the horse reach out.

Galloping Horse Wins Fifth Prize—$20.00

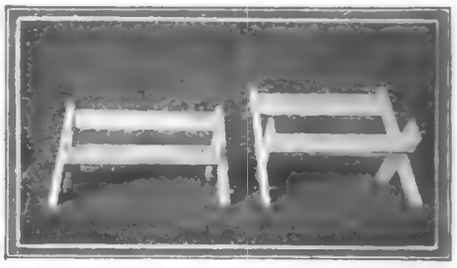
The next stage in the walking movement is indicated immediately above and the last is shown on the top of this column. The hind legs only are pivoted.

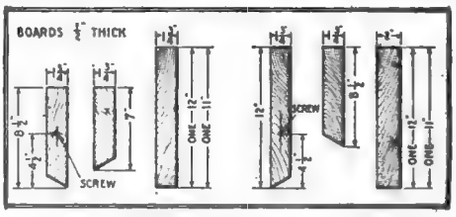




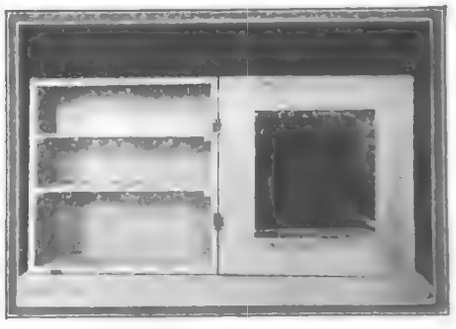


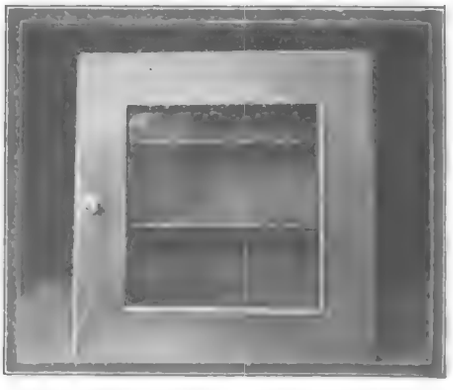
Seventh prize—$10.00 was won by Albert Seamann of Terre Haute, Ind., and is shown in the two photographs in the column at the left. The top view indicates this medicine cabinet in its open position and the bottom view shows the cabinet closed. It will be observed that there are two doors to this cabinet, one of which swings downward to permit of access to bandages, first aid material, and poisons and the cabinet at the top is for medicines which may be taken internally. The danger of accidentally taking poisonous material is thus considerably lessened.





Sixth prize—$15.00 was awarded in the Board Contest to Carl Fichtner of Philadelphia, Pa., for a medicine cabinet and two photographic plate racks, both made from the four foot board in accordance with the terms of this contest. The two photographic plate racks are shown in the photographs above and the description for constructing them is indicated in the drawing. To the left there is a drawing showing how the board was cut to make the medicine cabinet.





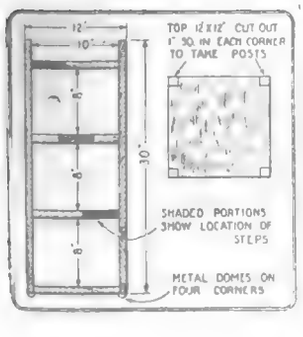
The two photographs above and the photograph and illustration adjacent to these in the column at the left show the construction of the medicine cabinet which won the sixth prize in this contest. Both cabinet and plate racks were made from the same board.

Contest Awards

Eighth prize—$5.00 was awarded F. L. Pattersen of London, Ont., Canada, for his example of a "Butler" ash tray holder.

Tenth prize—$5.00. The photograph above shows Cecil Everett Jones of Alliance, Ohio, and the "Butler" ash tray holder which he built and entered in the Board Contest. Mr. Jones calls this a "poor man's butler" and that is what practically all of the butlers on this page really are.

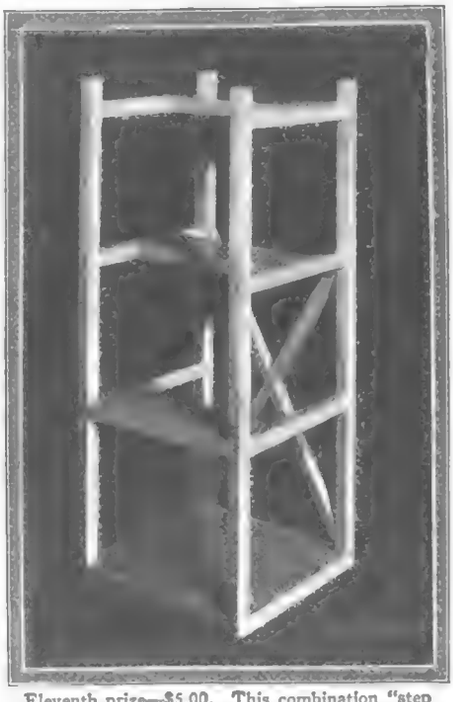
All three butlers which won prizes in this Board Contest were made of a piece of board 1 inch thick, 1 foot wide, and 4 feet long. They vary but slightly in general design and construction and it was difficult for the judges to finally reach their decision. It is obvious that the three ideas are not identical and therefore under no circumstances could a tie be announced unless of course, the opinion of the judges was not unanimous.



The diagram at the left shows how the combination high chair and step ladder was built. The sizes of the various parts are indicated.

The photographs on this and the preceding page show the list of prize-winners in the $300.00 Board Contest originally announced in the June 1926 issue of this magazine as continued from the first group of prizes published in the November issue. Due to insufficient space, this list was omitted from the December number as previously announced.

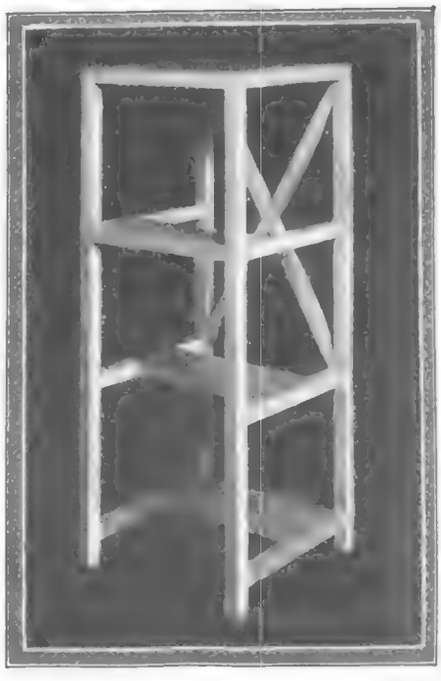
The eighth prize-winning design as shown from the other side. This ash tray holder will be found very serviceable and may be constructed from a board only 1 inch thick and 4 feet long.



Eleventh prize—$5.00. This combination "step ladder and high chair" was made by Forrest K. Green, of Memphis, Tenn. In the photograph immediately above it is shown in use as a step ladder. Note how the steps are staggered in the chair and serve not only to reinforce the chair, but as a means toward reaching inaccessible places. The posts on the sides of the chair will serve as handles for the ladder and as the legs of the chair when the device is inverted. The photo at the right shows the device in use as a kitchen high stool.

Ninth prize—$5.00 was won by Keith Barnes of Williston, N. D., for the butler indicated in the photo above and in the drawing at the right. This particular device is provided with a tray and will serve either as a card tray or as a holder for an ash tray. By enlarging the drawing shown at the right and sketching this on a piece of wood and then cutting the wood out, in accordance with the lines, the articles can be easily constructed.

The combination stool and ladder indicated in the photo at the left and the one immediately below makes an ideal acquisition to the kitchen. It is often difficult to do any work at the table when sitting in an ordinary chair. A stool aids materially in expediting such work. When the stool serves a dual purpose, its value is increased proportionately. The cost of the piece of board is small, consequently such an article is interesting.



WIREKRAFT

$3,000.00 IN PRIZES

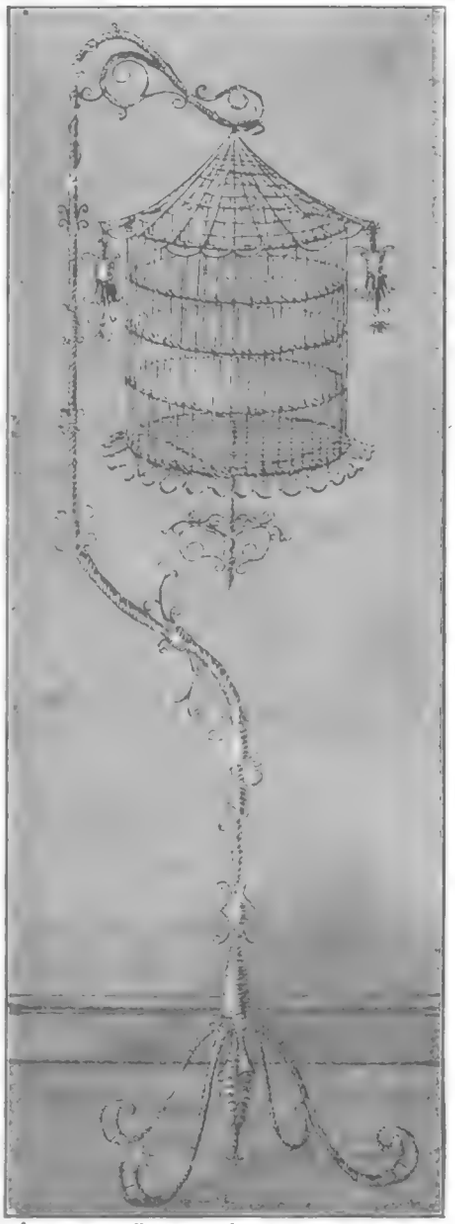
Above we have a photograph of a wire model of the Williamsburg Bridge.

This bridge model was constructed in the laboratories of this publication.

IN the last issue of SCIENCE AND INVENTION Magazine, we announced the coming of a new contest called Wirekraft. In this contest we request our readers to build things entirely of wire. While the Matchcraft Contest proved a great surprise not only to the editors of this publication, but also to its thousands of readers, because of the many novel objects which can be built entirely of matches, most of the match novelties possessed no utilitarian purposes and except for the few that can be placed on permanent exhibit, the remaining models will merely serve to perhaps clutter up valuable space in the book case. With Wirekraft, the articles or models made will be of a more substantial nature. There will not be as much difficulty in the shipping of the models and in event that the models are damaged in transportation, it will be much easier to repair them than it was to repair the Matchcraft models. While atmospheric conditions might rust some of the wire on some Wirekraft novelties, if care is taken in the selection of the wire, such rusting would not take place. The builder is also able to coat his Wirekraft novelty with paint or varnish, making it rust-proof, yet at the same time this paint would not effect any subsequent necessary repair.

In the last issue of this publication a group of articles of utilitarian nature was indicated. A reprint of this article may be had upon request if the readers will write in and make their request known. This article gives the complete details for the construction of Wirekraft models and also gives the contest conditions on which the prizes will be judged. These contest conditions are also found in this magazine toward the end of this article.

The articles on this page possess more or less of an artistic value and consequently with the possible exception of the picture frame and the Wirekraft bird stand and cage, the first prize would not be awarded to any of them. The rules of the contest stipulate that the first prize award will be given to only a device possessing a utilitarian value. There is very little of utility in the picture frame and considerably less in the model of the Williamsburg Bridge, the airplane model and the model of the pile driver. The bird cage alone possesses the greatest possibility of winning the first prize. The contest itself having not yet officially started and inasmuch as all of these models were built in our own experimental laboratories, none of them possesses a possibility of winning any of the prizes. They are merely given here for what value they may have in instilling new ideas in the minds of the coming Wirekrafters.

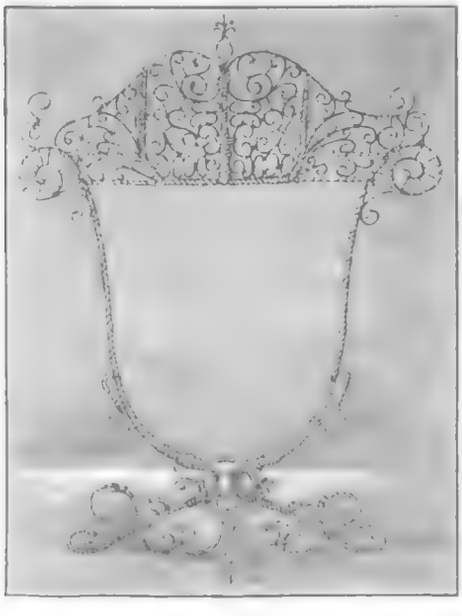


A very excellent sample of Wirekraft is indicated by the bird cage and stand shown in the photograph above.

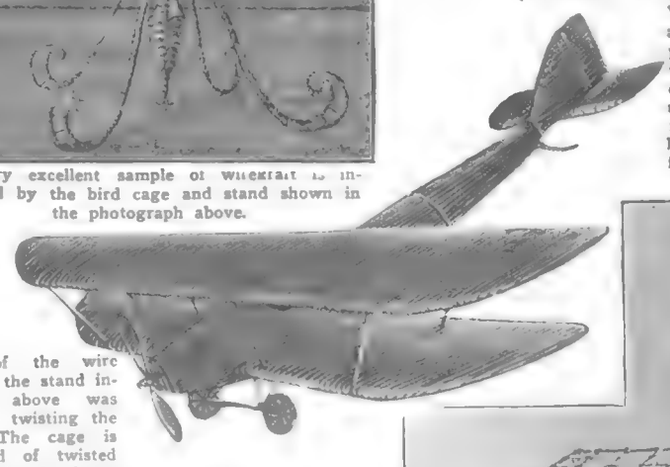
The Williamsburg Bridge model at the top of this page is a little more than three feet long. In its construction different sizes of wire were used, the towers and main span as well as the cables being heavier than those pieces of wire serving as the railings and as the suspensory cables. The wires were both twisted together and soldered together at their points of contact or union.

In the bird cage stand, also illustrated on this page, advantage of twisting the wire was taken. The stand itself is reinforced by twisting several pieces of wire together and in order to enhance the decorative value, copper wires and alloyed wires were employed which give the stand a striking appearance. Little touches of white paint here and there further enhance its artistic effect. The scroll design is accomplished by bending some of the stiffer grades of wire with a pair of round-nosed pliers. These scrolls are then secured to the upright stand by wire wrappings which in order to make them more rigid, might be soldered to the stand, but which in this particular model were merely wired to the stand.

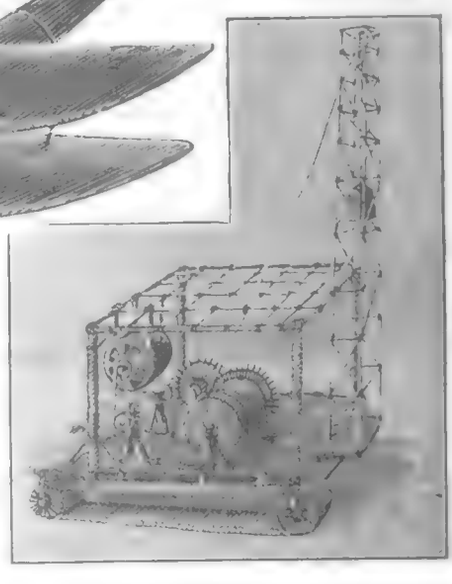
(*Continued on page* 853)



Most of the wire work in the stand indicated above was done by twisting the wire. The cage is composed of twisted and soldered wires.



While this model of an airplane is composed entirely of wire, the builder could have employed the wire for merely forming the framework and could have covered this framework with silk.



A unique picture frame can be constructed of wire as indicated in the photograph at the left. This demonstrates only one of the many possibilities of employing wire for the construction of models in this prize contest.

At the right we have a working model of a pile driver actuated by an electric motor. Notice that the gears themselves are also made of wire. One will note that the caterpillar treads of the pile driver are made of short pieces of rather heavy wire bound together by much thinner, more flexible wire.

$5,000.00 Matchcraft Contest Awards

Hat Box Wins First Prize---$100.00

This photograph shows the hat box which won the month's first prize award for Mr. Eugene Jeffries of Anacortes, Wash.

Miss Hazel June Park posing with the prize-winning band box. From this photograph one can get an idea of the size of the prize-winning Matchcraft model.

This month's prize winning Matchcraft model is made of a single layer of matches on the sides, bottom and top cover. These are glued end to end and side to side, forming thin veneer-like constructions. Both the inside and the outside of the hat box is smoothly sandpapered so that the matches themselves are only about half as thick as when found on the market. More than 5,000 matches entered into the construction of this band box which is 13 inches in diameter and 8½ inches high. Contrary to ordinary expectations, the box is much stronger than one might at first suppose it to be.

The last of the Matchcraft awards in the $5,000.00 Matchcraft Contest which has been running for the past year and which terminated on December 1st, 1926, will be announced in the February issue of SCIENCE AND INVENTION Magazine. Those of our readers who have become interested in the Matchcraft Contest and found that, because of the time limit they were prevented from entering this contest, need not fret. The publishers have decided to continue the Matchcraft Contest until further notice with a change in the list of prize awards so that now five prizes will be awarded monthly instead of the usual sixteen. The list of prizes may be found below and the same rules will of course continue in force.

We would advise all Matchcrafters to continue submitting their models and enter them in this new contest.

$100.00 Monthly Prize "Matchcraft" Contest

DURING the past year SCIENCE AND INVENTION Magazine awarded $5000.00 for articles made entirely of matches. While this $5000.00 contest has officially expired, the publishers have decided that because of the great popularity in Matchcraft constructions, the contest would continue in force on a new prize rate basis until further notice. The list of new prizes will be found in the center box and the same rules for the first contest are to be observed in this contest.

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

IMPORTANT

ON December 1st, 1926, the $5,000.00 Matchcraft Contest officially expired. Any entries arriving after that date were entered in a $100.00 monthly Matchcraft Prize Contest which will continue until further notice offering the following prizes:

First Prize	$50.00
Second Prize	20.00
Third Prize	15.00
Fourth Prize	10.00
Fifth Prize	5.00
Total	$100.00

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

This is a monthly contest and will continue until further notice. Each monthly contest closes on the first of the month following date of issue. Thus the contest for the month of January will close February 1st and prize-winning announcements will be made in the April, 1927, issue. The February issue will contain the last of the prize-winning entries in the $5000.00 Matchcraft Contest officially closing December 1st.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

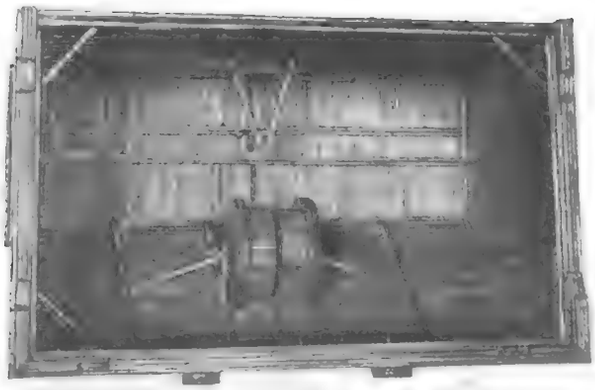
(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

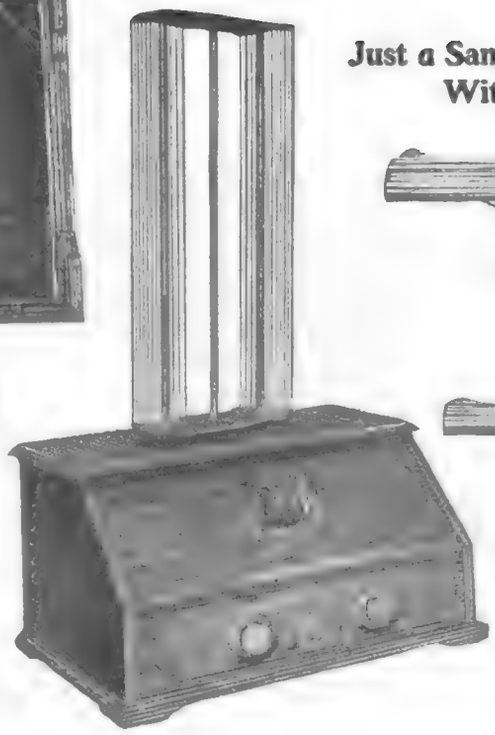
$5,000.00

Just a Sample of What You Can Do With Matches and Glue

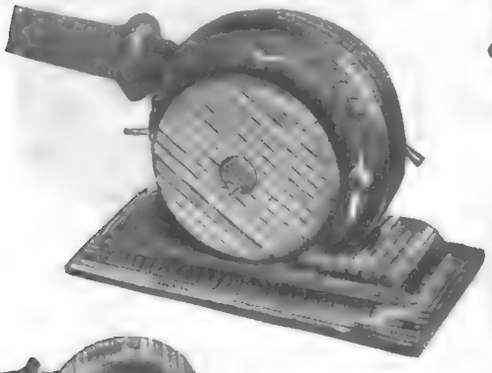


Second prize—$75.00, awarded to Paul R. Wotton, Friendship, Me.

The above photograph illustrates the bottom view of a Radiola, made entirely of matches. Note that the supports for the dials are also match constructions and the dials themselves are made of the same material. The outside of the cabinet is finished very artistically and is provided with a loop for reception, as well as the necessary control knobs. This is illustrated in the photograph at the right. The Radiola is 10½ inches long, 5⅓ inches high, and 6¼ inches deep.



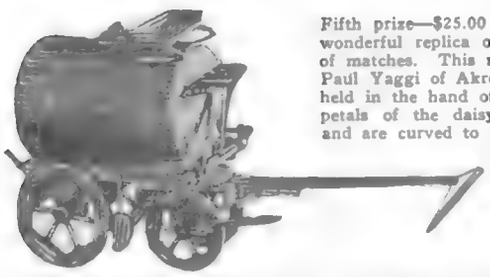
Third prize—$50.00. As perfect a replica of a revolver as could possibly be built was sent to us untagged. The trigger moves, the barrel rotates and the gun may be "broke" by releasing the catch.



Fourth prize—$35.00 was awarded to the builder of this air turbine, Francis L. Lorenze, of Sayre, Penna. By blowing into the tube, this air turbine can be rotated at a humming speed. It may be instantly taken apart and reassembled as the next photograph shows.

This photograph shows the turbine taken apart. The base, the case, the flywheels, the rotor and the pins are all in evidence. It can be assembled very easily and practically instantaneously.

The back view of the daisy showing the construction of this side of the flower.



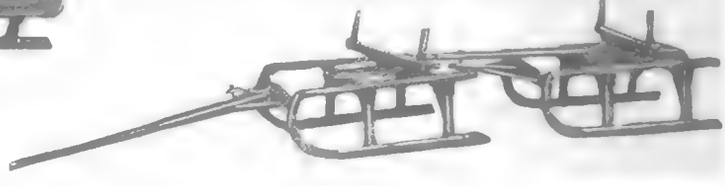
Fifth prize—$25.00 was awarded to a very wonderful replica of a daisy made entirely of matches. This model was built by Mrs. Paul Yaggi of Akron, O. It is seen being held in the hand of Miss Ruth Olsen. The petals of the daisy are shaved very thin and are curved to resemble the real flower.

Seventh prize—$15.00 was won by Howard E. Wandrei of St. Paul, Minn., for his water-wagon model here illustrated. Although the tank of the wagon is scarcely 2½ inches long, the brake shoes, foot pedals, wheels, etc., work.

The daisy illustrated in the photograph above measures 3 inches in diameter across the flower. The stem is built up of matchsticks glued together and the leaves are then cut up and glued, to be later painted like the real flower. It is difficult at a short distance to tell the difference between the two.

Sixth prize—$20.00 was awarded to Fred Spinden of Abingdon, Ill., for the sleigh. This sleigh is shown uncoupled in the photograph above. Now look at the photograph at the right and observe how the sleigh looks when assembled.

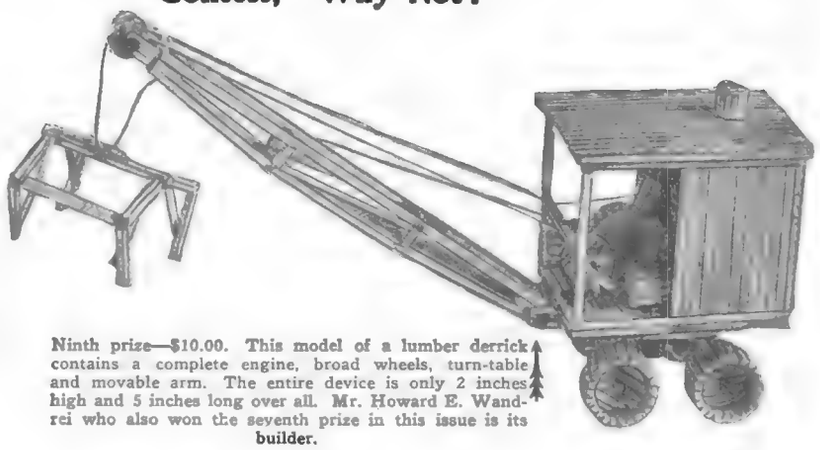
Completely assembled sleigh which won for its builder the sixth prize in this month's Matchcraft Contest.



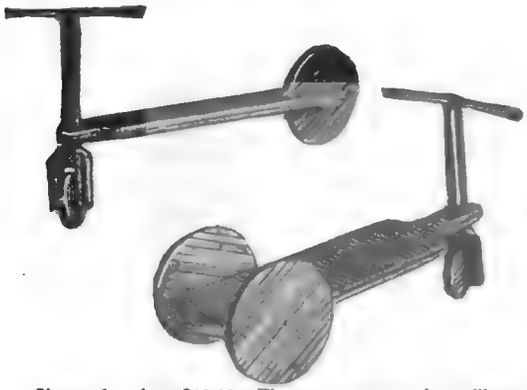
Matchcraft Contest Awards

If You Have Not Yet Entered a Model in the "Matchcraft Contest," Why Not?

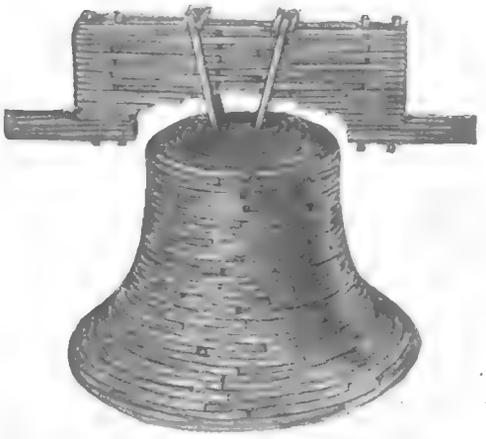
Eighth prize—$12.50. The rubber tired rickshaw here illustrated comes all the way from India and was made by R. D. Bennett. Three hundred and fifty matches were used in its construction. The hood, side lamps, cushions, axles, wheels, mudguards, spokes, etc., are made of the same material. The device is rubber tired.



Ninth prize—$10.00. This model of a lumber derrick contains a complete engine, broad wheels, turn-table and movable arm. The entire device is only 2 inches high and 5 inches long over all. Mr. Howard E. Wandrei who also won the seventh prize in this issue is its builder.

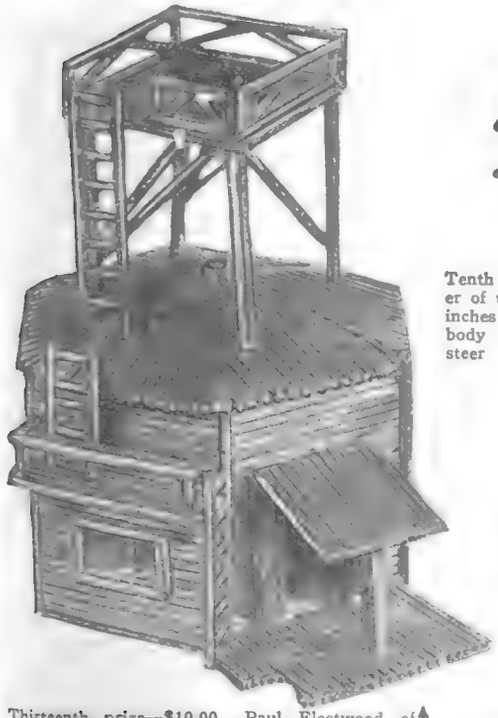


Sixteenth prize—$10.00. The two scooters above illustrated were entered by John Zeleznik of Bridgeport, Ohio and they won the last of the prizes in this month's issue. The front wheels of both scooters may be turned so as to steer the models which are approximately 2 inches long.

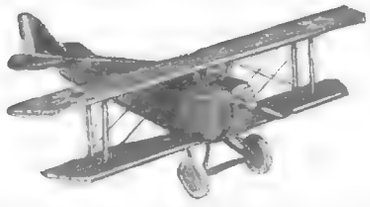


Fifteenth prize—$10.00 was won by J. Leland Myer of Leola, Penna., who built the Liberty Bell here illustrated. Notice how the matches were steamed and bent before they were glued in the shape shown.

Fourteenth prize—$10.00. A reproduction of the head of an antique was made of matches by Charles Vlodek of Czechoslovakia.

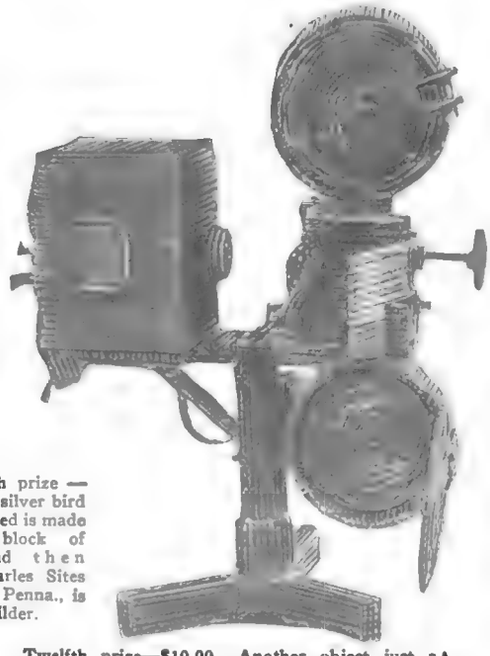


Thirteenth prize—$10.00. Paul Fleetwood of Charleston, S. C., built this outdoor shelter house which in this month's contest was awarded the thirteenth prize. An idea of its size can be gained by comparing the completed object with the size of a match representative of any of the sides of the shelter house.



Tenth prize—$10.00 was awarded to the builder of this unique airplane scarcely more than 6 inches across from wing-tip to wing-tip. The body is fitted with controls which elevate or steer the rudders. Made by Henry Geers, Woodmere, L. I.

Eleventh prize—$10.00. The silver bird here illustrated is made up of a block of matches and then carved. Charles Sites of Moheim, Penna., is the builder.

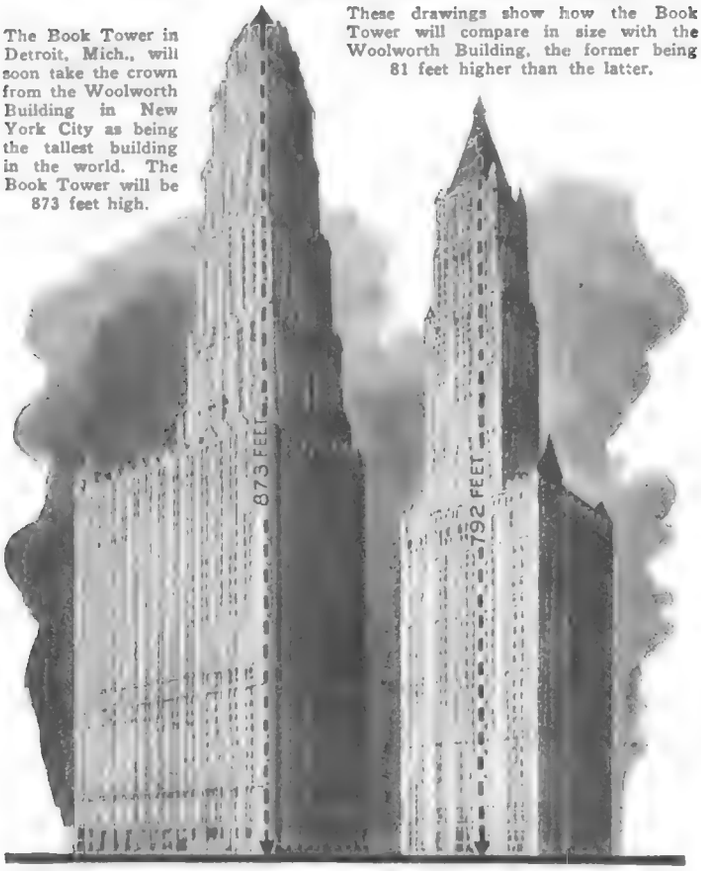


Twelfth prize—$10.00. Another object just a little different than any of its brother Matchcraft models is indicated in the photo above. It represents a motion picture projector and was made by Patsy Cordi of Derry, Penna. The model itself is 8½ inches high and all wheels, controls and belts are made of split matches.

World's Highest Building

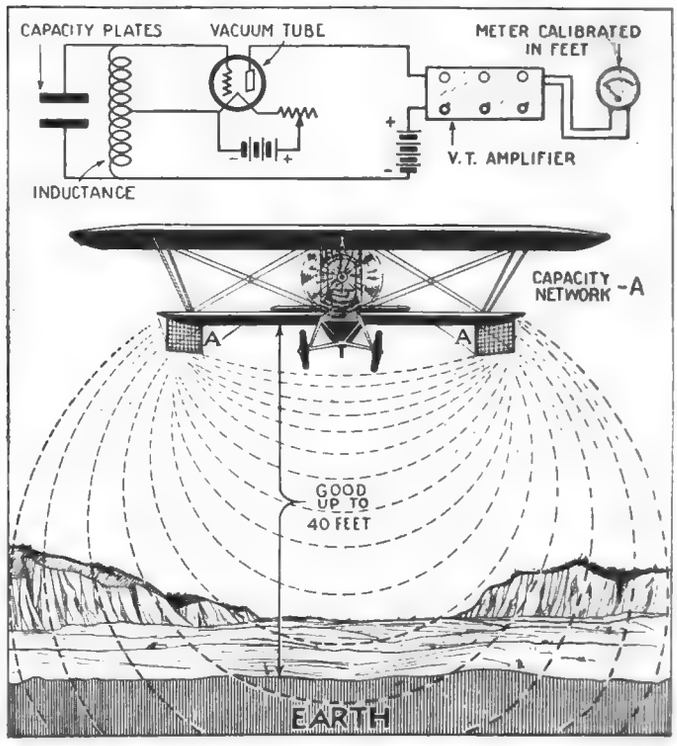
The Book Tower in Detroit, Mich., will soon take the crown from the Woolworth Building in New York City as being the tallest building in the world. The Book Tower will be 873 feet high.

These drawings show how the Book Tower will compare in size with the Woolworth Building, the former being 81 feet higher than the latter.



The Book Tower will be 85 stories high. It will dwarf any building in this country and everything abroad with the exception of the Eiffel Tower, the structure of which rises to a height of 1000 feet.

Tells Airplane's Height



DIFFICULTY of landing on a very foggy field has always been a great handicap to aviators. Up to the present time, no device has been constructed which will indicate to the aviator exactly how many feet he is above the ground. At the McCook Air Service Field at Dayton, O., Dr. J. H. Dellinger, chief of the Radio Laboratory of the Bureau of Standards of the Department of Commerce, has announced the development of an altimeter which registers the altitude of an airplane above the ground by variations in the capacity between the network and the earth. The system is effective to a height of 40 feet.

The Astrology Humbug

By JOSEPH H. KRAUS

Further Letters From Our Readers and Our Answers

QUESTIONS OUR ABILITY

Editor SCIENCE AND INVENTION:

We would like to inquire if either of the writers (*H. Gernsback and Joseph H. Kraus.—Ed.*) of the two articles on Astrology in the October issue of SCIENCE AND INVENTION have ever made a personal study of Astrology.

CHAS. A. LOGAN, D.A.
Fellow American Astrological Society,
Fairhope, Ala.

(Neither Mr. H. Gernsback or the writer are astrologers. We do not lay any claim to this title, nor is it necessary for us to be astrologers in order to write about the subject.

Would we have to be criminals in order to write about crime? Would we have to be a woman in order to write about women's disorders or to write a book on obstetrics? Would we have to be a Henry Ford in order to write about the automobile industry or a street car conductor in order to write about transportation?

Just what do you mean by a pesonal study of astrology? You do not assume for one moment that we do not look into a thing at all before we write about it. Of course, it is unnecessary for us to eat a whole bad egg in order to be able to tell whether it is rotten. It is likewise unnecessary for us to spend 30 or 40 years of research on a subject which on its face value is inaccurate and incorrect. We have proven that the subject is incorrect and have proven that even the astrologers themselves know not whereof they speak. If individuals who are supposed to know the subject cannot prove it, it is reasonable to assume that the idea cannot be entertained.—Editor.)

GET AFTER THE HIGHER MEN

Editor SCIENCE AND INVENTION:

Upon reading your article "The Astrology Humbug" in October number of SCIENCE AND INVENTION, I cannot help but feel that all is not as it should be, for merely denying or denouncing does not of itself prove a thing false.

The Ancient Science of Astrology could not have persisted throughout the ages until today were it not founded upon SOME rock of Universal Truth.

When you deny any truth in Astrology, just because you have tested one or many so-called "Astrologers" and found them wanting, you have only proved the falsity of these individual charlatans and Lord knows the country has many of them. You might just as well condemn and deny any fact or truth in Christianity because some of the professional preachers and teachers of it have in times gone, proved false and corrupt.

It is good and well that one and all should be exposed, in fact it would be a beneficial law that all so-called professional Astrologers be made to demonstrate ample proof of their ability to read the message of the stars aright and convince the world that they CAN predict the future correctly. (*We doubt they can.—Ed.*) We will both agree that not many (*Not any.—Ed.*) would receive their license to practice; of all who failed and did so practice they would be "Astrological Humbugs" and guilty of obtaining money under false pretenses.

Yours is a good magazine and as such must wield a power—for good. Then, if you must attack astrology, let me ask you why do you not attack those Strongholds of Astrological learning that exist and flourish in the west today. I would like to see you train your shafts of criticism upon these centers of Learning—test these out—forget about the poor little individual "Humbugs", get these high seats of astrological Learning where they will have to show the world their proofs to the satisfaction of the world at large, do not stop at the cheap evidence but go after the big game.

An exposé of these Schools of Astrology would be a blow at the very root of this "Humbug" and prove a blessing to all who are anxiously desirous of obtaining light upon an otherwise dark subject.

To aid you in this matter, I am sending you a copy of "Practical Astrology." Look it over, perhaps the editor would be glad to accept your offer of award for a successful test of the science. Look inside the covers and you will find the names of some of the finest professional astrologers of the day.

Also I would call your attention to two of the most powerful schools of astrological learning in this country to wit: "The Brotherhood of Light" and "The Rosicrucian Fellowship", Oceanside, Cal.

If you want to do a real lasting service to humanity, put these organizations to the test as you did our poor little humbugs, for these are the big seats of high learning, the Brotherhood of Light being the greatest of all insofar as Astrological Lore—knowledge, learning and wisdom is concerned. Test them out. Expose them once and for all that this relic of mediaeval superstition may be abolished, for I believe as St. Paul says, "Test all things, hold fast to that which is good."

(*Continued on page* 856)

$6,000.00
For Proofs of Astrology

SCIENCE AND INVENTION Magazine holds that there is nothing scientific in Astrology, that Astrology is not a science and that statements made by astrologers unless very general cannot be entertained seriously.

Accordingly, this publication has decided to award an Astrology Prize of $6,000 for the following:

$5,000 will be paid to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same. He must describe in advance each event in detail, giving the location and result or the casualties if the event is an accident.

$1,000 will be paid to the astrologer or forecaster who will produce three accurate, detailed and perfect horoscopes, free of contradictions on the lives of three people whose initials will be given him when he requests the same and the birth dates and place of birth will also be supplied by this office.

This contest closes October 1st, 1927, and all entries must reach us by that time. In event of a tie, prizes of an identical nature will be given those so tying.

Address all entries to Editor, Astrology, care of SCIENCE AND INVENTION Magazine, 53 Park Place, New York, N. Y.

MOTOR HINTS

Conducted by GEORGE A. LUERS

A New Monthly Department Prepared by a Well-Known Automotive Engineer

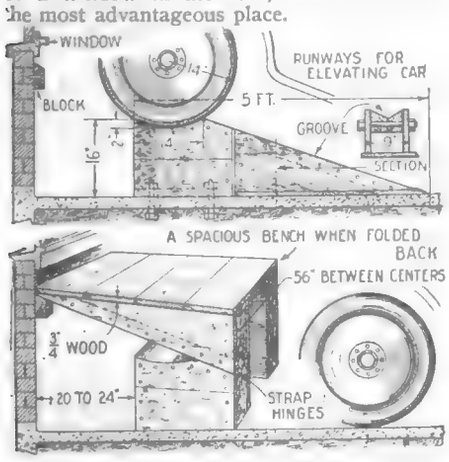
Do You Know—.005 Inch Extra Valve Tappet Clearance Adds Mountain-Climbing Ability to the Engine.

A SERVICE STATION FEATURE IN THE PRIVATE GARAGE

The writer is frequently asked for means to elevate the car, which will afford access for oiling, greasing and repairing, such a means as the inclined runways at the service stations.

In the attached sketch, is shown an inclined runway, which affords access to the underside of the car, surmounting the obstacles presented in the late models of cars, in which the chassis and running gear is extremely close to the ground.

This runway, is made so to fold and form a wide and commodious bench at the rear end of the garage. With the usual location of a window in the rear, this bench is in the most advantageous place.



A strong, yet simple form of incline up which front of car can be run to raise engine above floor. Forms a seat when not in use.

In making up these inclines, use good stout lumber and drive spikes liberally. Mainly the parts can be made up from ⅞-inch lumber for the sides, with four by fours to form the wheel supports.

A groove through the inclined runways, aids in keeping the car at the centers of the supports.

The advantages in this construction will be evident to the car owner from the sketch, which requires practically no building instructions.

In building, it is advantageous for working space to keep the high end of the inclines twenty or twenty-four inches from the rear wall, so as to pass through this space when getting underneath the car.

A SPRAY CAN FOR EITHER CLEANING OR PAINTING WORK

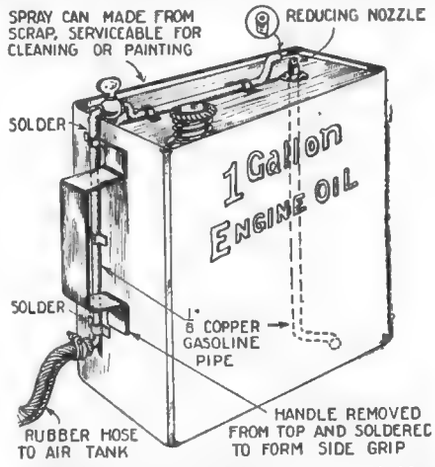
A simple spray device which meets the needs of one car owner, is shown in the attached sketch. This sprayer was made primarily for use in cleaning the owner's car of grease and oil. The idea will appeal to almost every owner, because of the simplicity of the device and the inexpensiveness with which it can be made up.

A gallon oil can having a screw lid, was first fitted with a sheet metal side handle, this being unsoldered from the top of the can and soldered to the side.

A piece of gasoline pipe, copper, was bent and inserted in a small punched hole in the top of the can, and then soldered tight.

A second piece of copper pipe was soldered to the container, so that the end would be at right angles to the first pipe.

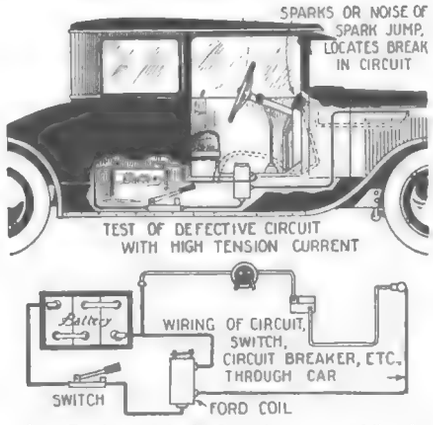
A small reducer was made of brass and soldered to the top of the pipe inserted in the can. A small rubber hose connection from a tank of air, which is compressed by


SPRAY CAN MADE FROM SCRAP, SERVICEABLE FOR CLEANING OR PAINTING
REDUCING NOZZLE
SOLDER
1 Gallon ENGINE OIL
SOLDER
⅛" COPPER GASOLINE PIPE
RUBBER HOSE TO AIR TANK
HANDLE REMOVED FROM TOP AND SOLDERED TO FORM SIDE GRIP

A simple, yet very useful spray can, suitable for painting and many other uses.

the power tire pump of the car, gives the supply of air. Kerosene is used in the can, for engine cleaning purposes.

The maker of this spray can, had occasion to paint his garage and at that time found


SPARKS OR NOISE OF SPARK JUMP, LOCATES BREAK IN CIRCUIT
TEST OF DEFECTIVE CIRCUIT WITH HIGH TENSION CURRENT
Battery
WIRING OF CIRCUIT, SWITCH, CIRCUIT BREAKER, ETC., THROUGH CAR
SWITCH
FORD COIL

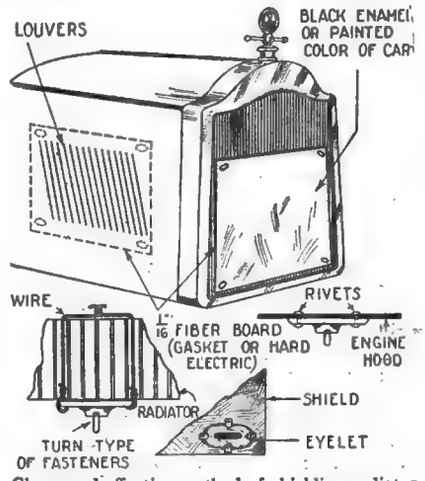
An effective method of testing automobile circuits for defective insulation by means of a spark coil.

the sprayer, when filled with a thinned mixture of paint, worked as perfectly as could be desired.

The sprayer is easily made up in a half hour of time, costs nothing and gives useful service, with a saving in muscular effort. The reader possibly has all the materials at hand for making this up.

TESTING FOR LOCATION OF BREAKS IN ELECTRIC WIRING

It is not practical always to determine just where a break in the electric wiring of the car, exists by removal of parts. As an example, the wiring from the battery to the



Cheap and effective method of shielding radiator and louvers in winter-time by means of fibre or other sheeting.

ignition coil of the car, will pass through the car chassis, under the dash, through a switch, possibly through a circuit breaker, junction panel and out to the ignition coil.

To avoid the difficulties and labor incident to tracing out a break in the circuit, a simple means is to use a high potential which will cause the current to jump the gap at the break and to indicate the place by the sharp noise of the spark and most likely to show the break visibly, when the car is in semi-darkness, as in the garage.

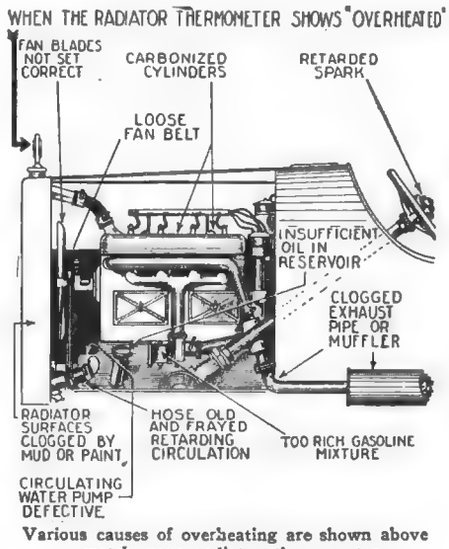
For purposes of testing, only a buzzer type of spark coil, as a Ford coil is needed.

This coil is connected in circuit with the battery of the car and with a single pole switch to connect to the circuit.

The diagram shows the simple connections in the high tension circuit.

The wiring under test, either ignition or lighting circuit, is obviously detached at either end. This method will show a break inside the insulation of a wire, for the insulation will heat and smoke when the current is kept on for several minutes.

(*Continued on page* 855)


WHEN THE RADIATOR THERMOMETER SHOWS "OVERHEATED"
FAN BLADES NOT SET CORRECT
CARBONIZED CYLINDERS
RETARDED SPARK
LOOSE FAN BELT
INSUFFICIENT OIL IN RESERVOIR
CLOGGED EXHAUST PIPE OR MUFFLER
RADIATOR SURFACES CLOGGED BY MUD OR PAINT
HOSE OLD AND FRAYED RETARDING CIRCULATION
TOO RICH GASOLINE MIXTURE
CIRCULATING WATER PUMP DEFECTIVE

Various causes of overheating are shown above —watch your radiator thermometer.

Into the Fourth Dimension

FIFTH INSTALLMENT

First American and Canadian Serial Rights

By RAY CUMMINGS

CHAPTER X

CAPTURED BY THOUGHTS MALEVOLENT

AS the followers of Brutar burst into the globular amphitheatre with shouts of menace, a confusion—a chaos—a panic descended upon the gathering. Everywhere the people were rising to flight; struggling to escape, struggling with each other, aimlessly, unreasonably, with scarce the steady thought to distinguish friend from foe. The stools upon which we had been sitting were overturned; the floor around me, and above me was grey with its surging occupants; they were floating inward, struggling groups of them; the air soon was full of them, like feathers tossed in a breeze. I could feel the breeze now—a turgid motion of that imponderable, invisible fluid for which I have no other name save air; a breeze caused by the fluttering things which were ourselves.

It seemed—as the idea came to me from some dim recess of that other mind which had been mine—it seemed an aimless struggle. I was clutched by a dozen groping hands—pressed by half as many bodies. I saw them—indistinguishable as they rocked against me; and felt them dimly. I fought back, clutched at emptiness; or caught something solid. Pushed it violently away, to see it float off, and feel myself drift backward from the recoil of my blow, the physical futilely struggling with its own tangibility.

A whirling gray shape, definitely outlined in the fashion of a burly man, bore down upon me. It halted, gathered its poise, and confronted me. A length away, with empty space between us, it stood motionless. Brutar! Recognition came to me; and I knew then that this was the shape they had termed the first of the ghosts—that spectre we had seen on the bank of the little creek in Vermont. Brutar—he who was leader of these invaders we had come to check. The desire shot through me to attack him now; to kill him.

I plunged; but as though I had leaped into some unseen entangling veil I was halted; pushed backward until again I found myself facing him. He had not moved. With folded arms he stood regarding me. I stared into his eyes. They were glowing, smouldering torches. A wave of something almost tangible was coming from them; and abruptly I knew that it was his thoughts in a wave so ponderable I could not force my body against it. I could feel it, this wave; feel these thoughts, malevolent, commanding, compelling, as they beat against me.

He spoke. "You need not try to move. You cannot, except as I would have you move."

The words seemed inherent to all the space about me; it was almost as though the words themselves were ponderable; but it was the thought of them—his thought of them—which like a net had me entangled. I struggled, if not to advance, then to retreat. I could do neither. The wave had coiled about me. Matter of a tangibility almost equal to that of my own body, it held me enmeshed. Yielding as I fought with it, but holding me as a delicate net will hold a struggling fish.

He spoke again. "Be still—both of you."

Both of us! I became aware that Bee was beside me. Floundering, swept inward toward me, to grip me at last and cling.

"Bee! Bee, dear."

"Rob! It's you! I'm so glad. I tried—I can't get away. I'm entangled—it's all around me. Both of us—we can't get away."

I had no coherent thought remaining, save relief that Bee was with me. I tried to think that I must escape—must kill this Brutar. Like an echo, as though I had shouted them aloud, the thoughts rebounded to beat against my brain with a pain almost physical. I could not think them again. A wall was around me reflecting them back—distorted, agonized echos, impotent to pass the barrier. And I thought, "I must kill—I—I am glad Bee is with me. Everything is all right—Bee is with me." And yielded, to stand there helplessly clinging to her.

Around us—beyond Brutar's entangling, engulfing whirl of thought—I perceived a dim vision of struggling shapes and confused sound. Far away—very far away—far away in distance—in Space; and in Time as well—Why of course—that struggle in the meeting house was in the Past—We were there no longer, either in Space or Time—That struggle in the meeting house *had been*, but it was not *now*.—

Bee was still clinging to me. Like submerged swimmers sucked away in an undertow, we swirled within that enveloping thought-wave. Brutar was near us. I could see him—see the grey hovering shape of him. Darkness was everywhere. Solidity gone, save the press of those hostile thoughts and the blessed tangibility of Bee within the hollow of my protecting arm.

A chaos of moving darkness. Or was it that the darkness was immobile and ourselves rushing through it? A chaos of things which I could not see; thoughts which I tried to think, but could not. Thoughts rushing past me; entities invisible, uncapturable.

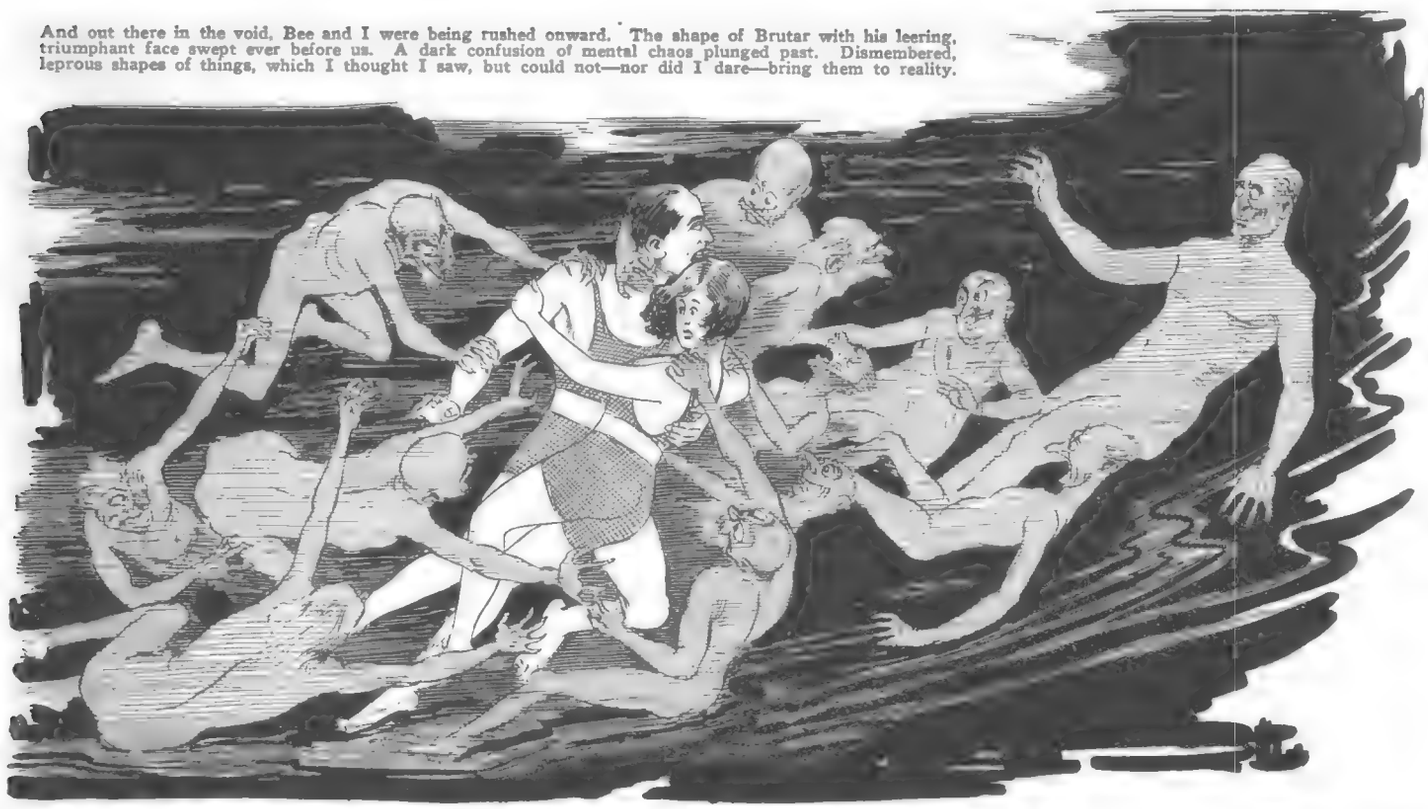
For what length of Time or Space I do not know, Bee and I whirled onward through that dark mental chaos—imprisoned, with our captor leading us.

CHAPTER XI

THE UNIVERSE OF THOUGHT

I SHALL revert now to Will's experience during that attack upon the meeting house as he later described it to me. He had been crouching near Ahla. When the hostile shapes burst in, he clung to her. Will was more alert than I to the conditions of

"You need not try to move, you cannot, except as I would have you move." These thoughts held us entangled like a net. I tried to think that I must escape—must kill this Brutar.



And out there in the void, Bee and I were being rushed onward. The shape of Brutar with his leering, triumphant face swept ever before us. A dark confusion of mental chaos plunged past. Dismembered, leprous shapes of things, which I thought I saw, but could not—nor did I dare—bring them to reality.

this strange existence. He gave no thought to a physical violence; he knew it was the mental struggle which was to be feared; and he kept his mind alert, aggressive to attack.

Ahla too, was of help. He heard her murmuring, "Be very careful. Let no evil thought-waves engulf us."

A shape whirled up—a leering man. But Will's thoughts were stronger. The waves clashed with a visible front of conflict; a faint glow of luminous black, in a very palpable heat. The shape cowered, retreated, slunk away.

Everywhere the struggle was proceeding. Upon the center ball Ahla's father stood, and with roaring voice and a will more defiant than any within the globe, he strove to quell the invaders. Beat them back. Some retreated; some fell, lying crumpled and inert. Dead? We may call them so. Bodies unharmed. Minds driven into darkness; driven away, to leave an empty shell behind them. Soon the confusion was over. The amphitheatre was strewn with mindless bodies; the dead—never to move again, and others, injured; minds unhinged—irrationally wandering, to return, some of them, to reach again their accustomed abode.

AHLA'S father—they called him Thone—found his daughter with Will; took Will to his home, where for a nameless time they were together, exchanging friendly thoughts that each might know what manner of world was his friend's. To Will it was the first rationality of this new realm. They reclined within a globe of luxurious fittings which gave a sense of peace, luxury, well-being of the mind, derived by what means Will could not say. He only was aware that Ahla was beside him, her father facing them.

He had thought of Bee and of me with fear—had wondered where we were, had wished we were with him. But Thone had told him not to be afraid. It was so easy to wander. We had not come to harm within the meeting house. We would presently come back, or if we did not, he would send out and find us.

The interior of the globe was vaguely luminous. Thone said, "We would perhaps be more comfortable if we could see outside." He murmured words—commands spoken aloud; and a shell of the globe in a patch above them slowly seemed to dissolve—or at least become transparent, so that they saw through it a vista of the city of globes—a city lying then in the vertical plane with the black void of darkness to one side.

Synopsis

Robert Manse, a correspondent in the New York Office of a Latin-American export house, in company with Wilton Grant and his sister Beatrice, saw the first of the ghosts in February, 1946, a few miles from Rutland, Vermont. These ghosts were semi-transparent, glowing figures much resembling human beings. Attempts to destroy them with bullets or clubs had no effect on the shadows. Passing the hand through the space occupied by one of these ghosts produced no tangible sensation. Later, the ghosts became more bold and more numerous, even molesting human beings and causing at least one death in Kansas, the result of heart failure induced by the fright of encounter.

Some time later, Will calls Rob on the telephone, saying that his sister Bee is quite ill and asking Rob to pay them a visit. During the visit Will mentions that the ghosts have already arrived in the Borderland lying between their world and ours, and that they were on the point of coming into our world. Will himself has discovered a means of entering into this borderland, and declares that even though he is being watched by many of the ghosts he will make an attempt to-night to enter their realm and turn the spirit-like creatures back into their former paths. While he makes the journey, Rob is to stay behind with Will's sister, Beatrice.

The preparations for the experiment are made, and Will clasps upon his arm a connection to the vibration-transformer which, by altering the vibrations of his body, is to transform it from normal substance to the wraith-like material of the other world. They see a ghostly form watching them as Will's body becomes transparent, but finally the apparatus is disconnected and they wait for his return. Five hours later, Will returns saying that they must go back with him to save the world from an invasion of the ghostly hordes.

Robert and Beatrice, though face-to-face with the unknown, succeed in suppressing their fear, and agree to accompany Will across the border. The three adventurers don their metallic garments, attach the batteries, and swallow the acrid compound which is to transform their tissues. In a few minutes they find themselves transposed into the Borderland, and they alertly wait for what may come.

They meet Ahla who takes them to the big city where the houses are globular and are entered through the side walls. The triplet is told that Brutar is inducing his followers to enter our world. When in a meeting-house the great danger of doing this is being forecast, hostile forms break through the walls to attack those at the meeting.

Now continue with the story.

THONE was a grave man of dominant aspect; eyes from which shone a power of mind unmistakable. He listened silently while Will tried to describe our Earthly existence. Occasionally he would question, smiling his doubts. At last he said, "It seems very queer to have the mind so enchained by its body."

Then Thone spoke of his own realm. "We Egos—" The word struck upon Will's consciousness with an aptness startling. Egos! Why of course. These were not people. He—himself—was no longer a man; an Ego, little more.

"We Egos live so different a life. It is nearly all mental. This body—" He struck himself. "It is negligible."

Soon they were plunged into scientific discussion, for only by an attempt at comparison in terms of science could Will hope to grasp the elements of this new material universe. He said so, frankly; and Thone at once acquiesced.

"I will try," he smiled, "to tell you the essence of all we know of—shall we call it the construction of this universe of ours? All we know. My friend, it is only the wise man who knows how little is his knowledge.

"Our world then is a void of Space and Time. The Space of itself is Nothingness, illimitable. Yet to our consciousness it has a shape, a curvature, like this that is around us now." He indicated the hollow interior of the globe. "To traverse it in a single direction, one always tends to return."

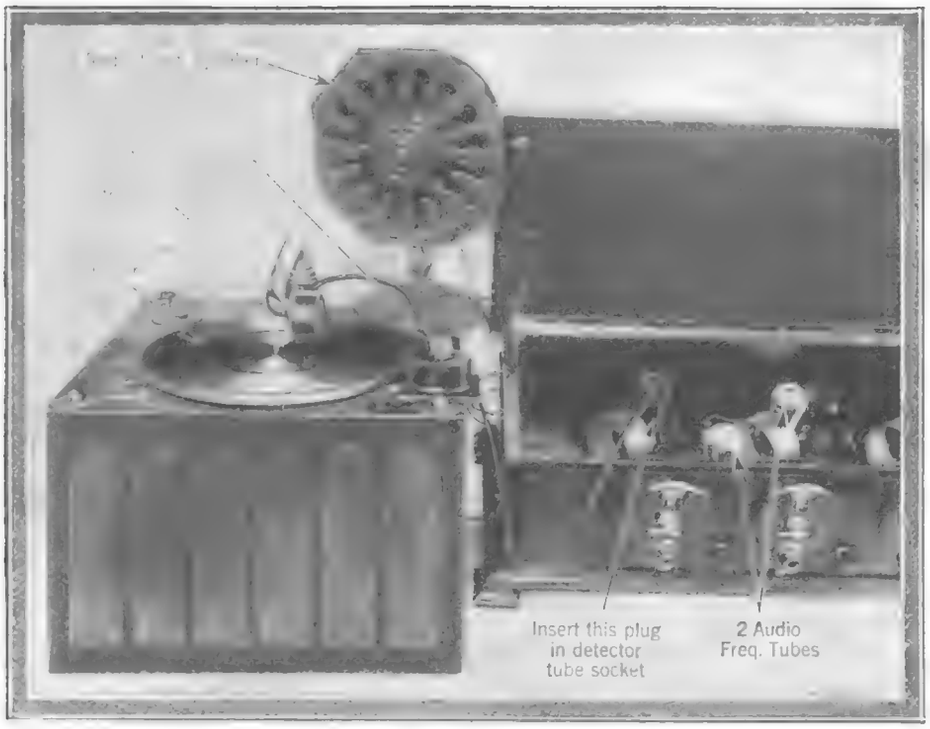
Will said: "A globular void of Space. I can understand that. But how big is it?"

"There is no answer to such a question," Thone replied gravely. "To our material existence, our consciousness, it is a finite area, yet within it some of us may go further than others. A mind unhinged takes its body very far—or so we believe—and yet sometimes returns safely. A mind departed

(*Continued on page* 839)

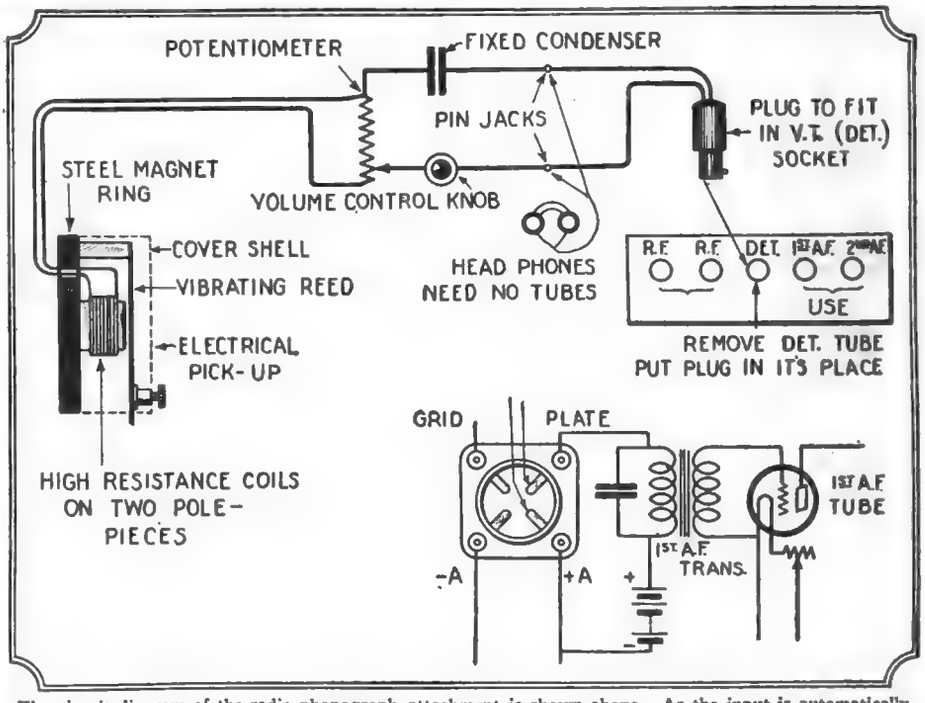
Amplifier Rejuvenates Phonograph

AT the left is illustrated a device recently placed upon the market by a well known radio manufacturer which utilizes the audio-frequency amplifier of a radio set to amplify the sound of a standard phonograph. An electrical pick-up of the magnetic type is attached to the tone-arm in the place of the regular reproducer and a plug is provided which fits into the detector socket of the radio set. A potentiometer is used to regulate the volume. Below is given a diagram of the apparatus incorporated in this unit, showing the construction of the pick-up and wiring details. The electrical pick-up operates on a well-known principle. A fixed magnet of special type is provided with two-pole pieces wound in a fashion similar to that of the usual watch-case receiver and the needle of the phonograph is attached to a reed which vibrates in the field of the magnet as the needle moves across the record.



The new radio phonograph attachment is shown in the photograph above as it appears when hooked up to the radio. No extra batteries or accessory equipment are required other than those normally used with the radio set. The output of the phonograph plugs directly into the detector tube socket.

Photo courtesy David Grimes, Inc.

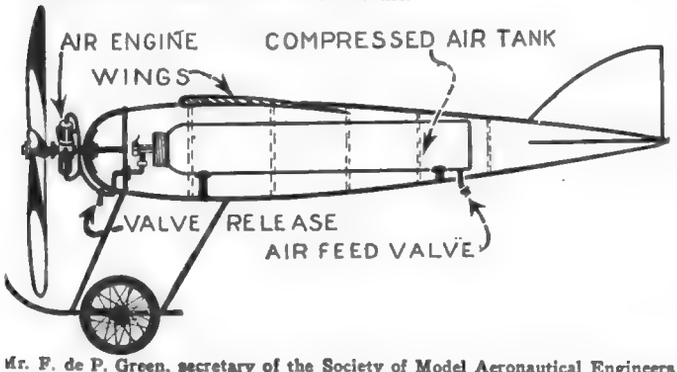


The circuit diagram of the radio phonograph attachment is shown above. As the input is automatically connected by means of a special plug which is inserted into the detector tube socket, no change in wiring is necessary. Any efficient type of loud talker may be used.

Sun Kills Germ Life

Dr. W. W. Coblentz of the Bureau of Standards finds that ultra-violet rays are highly effective as exterminators of bacterial life.

Model Plane Driven by Compressed Air



Mr. F. de P. Green, secretary of the Society of Model Aeronautical Engineers of Sudbury, England, designed the model plane shown at right and above. Motive power is furnished to a tractor screw by a three-cylinder compressed air motor. Successful flight over good distances was achieved.

Our Spiritualistic Investigations

NO. 6 OF A SERIES

By Dunninger.

Mrs. Brockman had the ability to materialize unusual things such as rabbits, flowers and doves, after both cabinet and surroundings were examined.

MATERIALIZATION is the greatest form of spiritual evidence the medium has for influencing the believer. The writer has witnessed many unusual and apparently uncanny demonstrations by some of the cleverest mediums in the nation. It may be fair to go so far as to state that these cheerful deceivers are artists, in their chosen profession.

On the other hand, there are many crude and cumbersome spiritual performances that are so badly presented, that the only mystery of the affair is based in the fact that the visitors to these seances, can not readily see through the methods the fakirs employ. In some of the smaller towns throughout the nation, these less competent mediums seem to be better established. In the larger cities, where the inhabitants are accustomed to frequenting theatres, and seeing many of the better mysteries offered by magicians, it seems more difficult for the medium to create a following. Therefore only those most competent and truly clever, have a chance of establishing themselves.

Several months ago, in Chicago, Ill., I witnessed one of the specialists at work. Mrs. Brockman was the medium in question. Creating a business-like method for development of her work, Mrs. Brockman would rent some of the smaller halls in which to interest and mystify her gatherings. She spoke with an accent, was a big, heavy set woman, well in the forties. Her husband, a man of apparently half her weight, who spoke slowly, and seemed to think deeply, was her business manager, and general lecturer. It seemed that upon the night of this marvelous demonstration, a number of scientists, physicians, and professors of psychology, had been invited. At least that is what Mr. Brockman told his audience, a gathering of some one hundred.

It seemed therefore an accepted fact that these learned gentlemen were present, as Mr. Brockman took pains to describe that an invitation had been forwarded to each of these men, together with a challenge to prove his wife's work anything but genuine. I looked about the audience, expecting to see some one acknowledge his statement, but a quick glance at the many faces created quite a doubt in my mind. The psychology of facial reading seemed to fail me deeply, or else the so-called professors had disguised themselves, so as not to disclose their identity.

The hall, badly lighted, was one of old fashioned design. A platform at the farthest end was elevated about two and a half feet above floor level. This platform was so erected as to stand some five or six feet away from any of the side walls. There was no scenery or hangings of any kind. Upon this platform stood two cloth covered cabinets. One of these was approximately five or six feet square, and about seven feet high. The other was likewise seven feet

(*Continued on page* 845)

$21,000.00 for Spirits

Dunninger, who writes exclusively for SCIENCE AND INVENTION Magazine and who is the Chairman of our PSYCHICAL INVESTIGATION Committee will personally pay $10,000.00 to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism, that he will not explain or that he cannot reproduce by natural means.

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent?

To the $10,000.00 which has been offered by Joseph F. Rinn through this publication for Spiritual proofs and the $1,000.00 in addition offered by SCIENCE AND INVENTION Magazine we now add Dunninger's $10,000.00.

So now we have a total of $21,000.00 offered for proofs of Psychical Manifestations. Spiritualists—get busy.

MODEL DEPARTMENT

Roman Ballista Wins Eighth Cup

J. H. Jones of Denver, Colorado, is the Winner of this Month's Science and Invention Trophy

THE romance of Roman times is recalled by viewing the photographs of the Roman Ballista which was entered by J. H. Jones of Denver, Colo., in the SCIENCE AND INVENTION Magazine Trophy Cup Contest and which won for him this month's coveted prize.

This magazine awards a handsome trophy cup 17½ inches high and weighing nearly five pounds for the best model of any existing object entered during the month. The judges considered that this model was superior to any other model entered. Not only does the Ballista accurately shoot a dart, but from an artistic standpoint, it forms an ideal decoration for a bookcase.

In ancient times these machines were used for hurling spears and burning torches. Many a castle surrendered following the onslaught of opponents using these machines of warfare. They were the forerunners of our modern cannon, but used no powder.

Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.

2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.

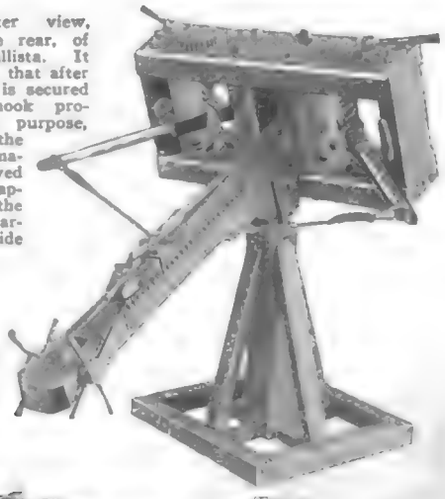
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.

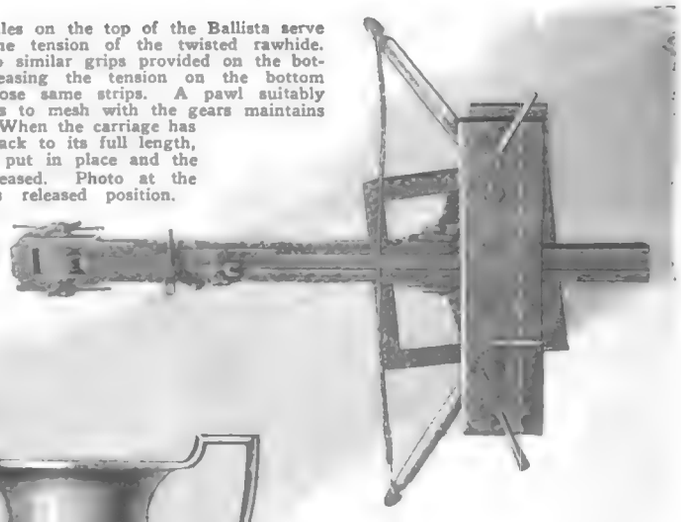
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the March contest must reach us on or before the 25th of December.

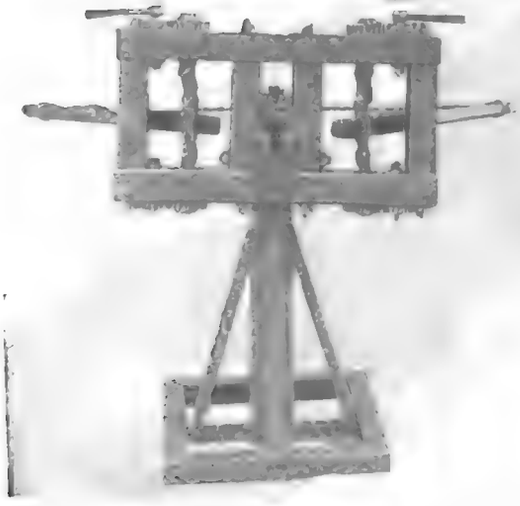
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 53 Park Place, New York City.

A three-quarter view, taken from the rear, of the Roman Ballista. It will be observed that after the bow string is secured beneath the hook provided for this purpose, the handles of the back of the machine are revolved and tension is applied, twisting the two vertically-arranged rawhide bands



The two handles on the top of the Ballista serve to increase the tension of the twisted rawhide. There are two similar grips provided on the bottom for increasing the tension on the bottom portion of those same strips. A pawl suitably arranged so as to mesh with the gears maintains this tension. When the carriage has been drawn back to its full length, the arrow is put in place and the trigger is released. Photo at the right shows released position.





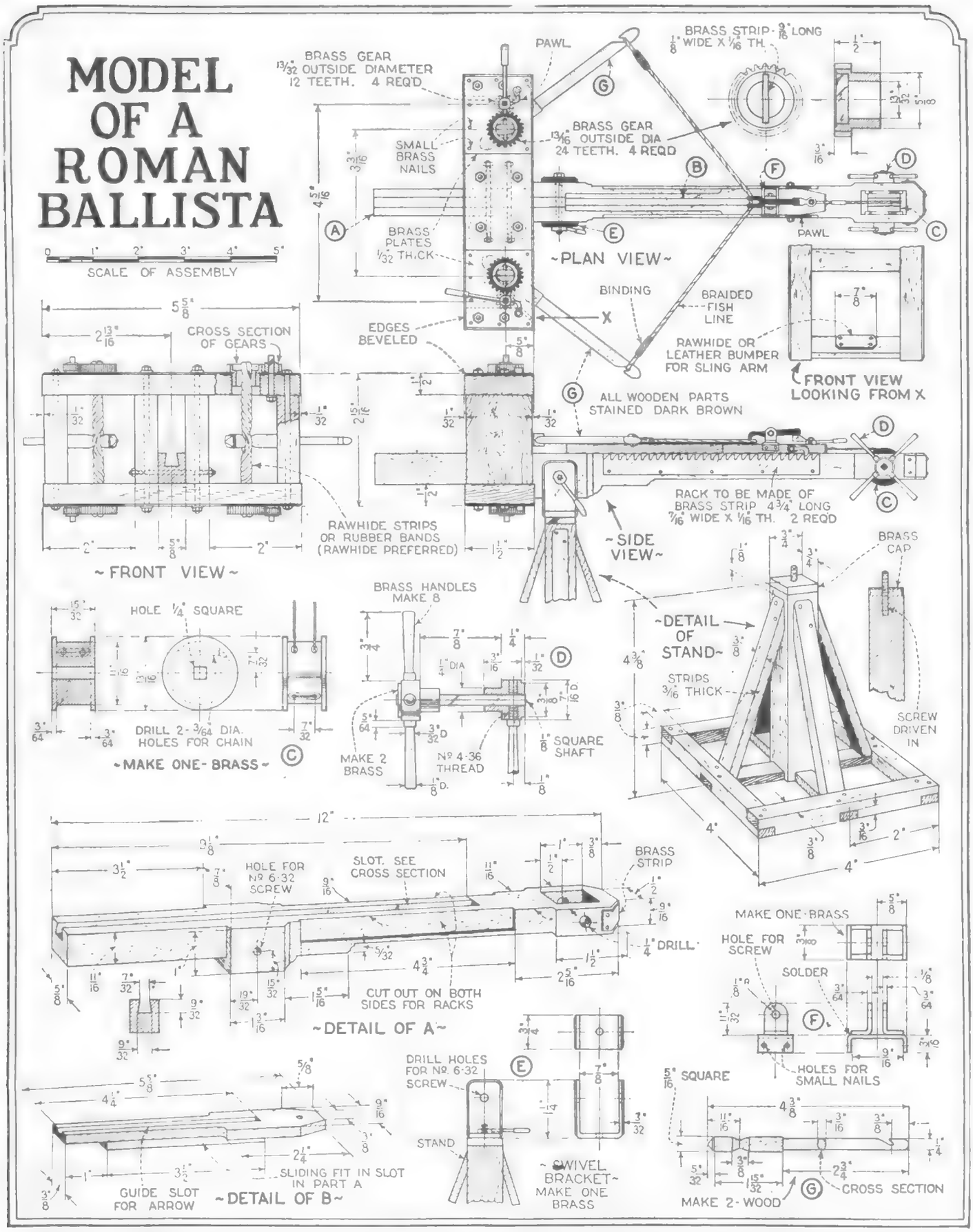
To the left we have a photograph of the model trophy cup which was awarded to Mr. J. H. Jones for model of a Roman Ballista found immediately at the right of this cup. The photo gives us an idea of the comparative sizes of both the cup and the prize-winning model. The cup itself stands 17½ inches high, while the model of the Ballista is 6 5/16 inches high.

The photograph at the extreme left gives us a front view of the prize-winning model. We would recommend that all of the model makers in this country enter their models for the trophy cup. One of these cups is awarded monthly.

If you would like your name on a SCIENCE AND INVENTION Trophy, enter your model now.

Drawings of this Month's Cup Winner

Blueprints of the Roman Ballista may be obtained for 50c. *from the Model Department.*


MODEL OF A ROMAN BALLISTA
SCALE OF ASSEMBLY
BRASS GEAR 13/32" OUTSIDE DIAMETER 12 TEETH. 4 REQ'D
SMALL BRASS NAILS
BRASS PLATES 1/32" THICK
PAWL
BRASS STRIP 3/16" LONG 1/8" WIDE X 1/16" TH.
BRASS GEAR 13/16" OUTSIDE DIA 24 TEETH. 4 REQ'D
~PLAN VIEW~
BINDING
BRAIDED FISH LINE
RAWHIDE OR LEATHER BUMPER FOR SLING ARM
FRONT VIEW LOOKING FROM X
EDGES BEVELED
CROSS SECTION OF GEARS
ALL WOODEN PARTS STAINED DARK BROWN
RACK TO BE MADE OF BRASS STRIP 4 3/4" LONG 7/16" WIDE X 1/16" TH. 2 REQ'D
RAWHIDE STRIPS OR RUBBER BANDS (RAWHIDE PREFERRED)
~FRONT VIEW~
~SIDE VIEW~
BRASS CAP
~DETAIL OF STAND~
STRIPS 3/16 THICK
SCREW DRIVEN IN
HOLE 1/4" SQUARE
DRILL 2-3/64" DIA. HOLES FOR CHAIN
~MAKE ONE- BRASS~
BRASS HANDLES MAKE 8
MAKE 2 BRASS
№ 4-36 THREAD
1/8" SQUARE SHAFT
HOLE FOR № 6-32 SCREW
SLOT. SEE CROSS SECTION
BRASS STRIP
1/4" DRILL
CUT OUT ON BOTH SIDES FOR RACKS
~DETAIL OF A~
MAKE ONE-BRASS
HOLE FOR SCREW
SOLDER
HOLES FOR SMALL NAILS
DRILL HOLES FOR № 6-32 SCREW
STAND
~SWIVEL BRACKET~ MAKE ONE BRASS
5/16" SQUARE
MAKE 2-WOOD
CROSS SECTION
GUIDE SLOT FOR ARROW
SLIDING FIT IN SLOT IN PART A
~DETAIL OF B~

The above diagrams explain in detail how a duplicate of the prize-winning model can be constructed. The chain for moving the carriage back may be obtained at a jewelry store. The arrow which this Ballista shoots with surprising accuracy and startling speed is 3⅛ths inches long. Its back end is feathered, the feathers being split, glued and bound to the arrow 120° apart. The point of the arrow is tipped with a brass arrow head ⅛ inch long and flat on the top and bottom surfaces. Use a straight grained piece of wood slightly tapered and ⅛th of an inch thick at the bow string end.

MAGIC By "DUNNINGER"

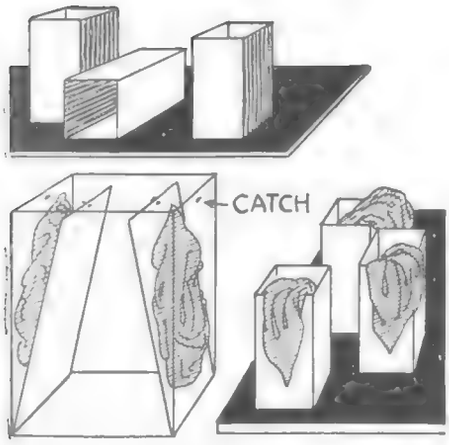
DUNNINGER
Joe Dunninger Tells How Prince Got Trick to Show Some Folks
DUNNINGER AMAZES TRIBUNE EMPLOYEES IN DEMONSTRATION
HYPNOTIST RULES SUBJECT BY RADIO
Reads Mayor's Inner Mind

THE MAN WHO MYSTIFIED
Pres. Coolidge
Prince of Wales. Ex-President Harding. Taft. Roosevelt. and other celebrities
Writes Exclusively for
SCIENCE AND INVENTION

Folks Are Mystified Yet Delighted by This Man!
Mind You! The Mind Reader Really Read the Mayor's Mind
DUNNINGER DRAWS BIG CROWDS
Dunninger Will Attempt To Hypnotize Patients 10 Miles Away by Radio

NO. 46 OF A SERIES

Boxes of Plenty

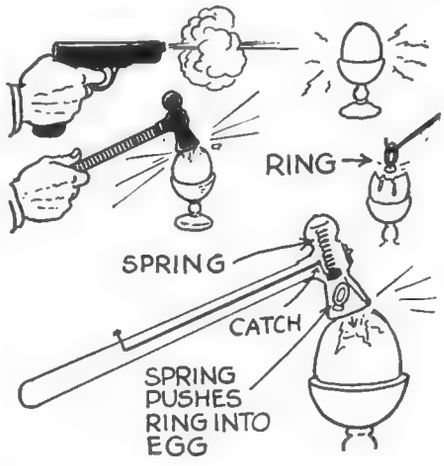


Three apparently empty boxes are shown the performer looking through them and the audience seeing his face on the other side. Due to the false sides, a large quantity of silks can be produced from the interiors.

IN this particular effect the performer shows three boxes opened at both ends. He looks through them to show that they are empty. On setting them down on a thin tray, he removes great quantities of silks from the inside of the boxes. The diagram explains how the effect is produced. It will be noted that two of the sides of the boxes are false and behind these the handkerchiefs are nested. On setting them down on the table, the performer merely releases the catches permitting of access to the kerchiefs.

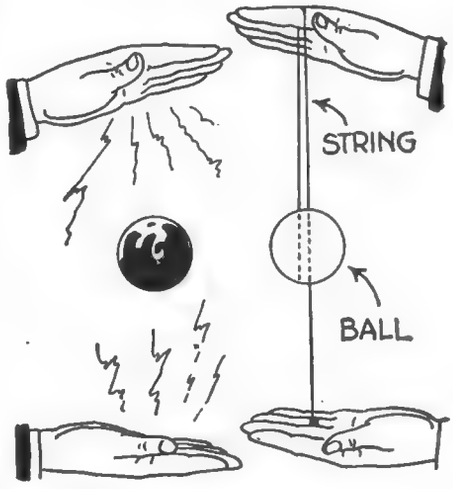
Miraculous Eggs

AFTER vanishing a ring, the performer requests that anyone bring an egg to the stage. This egg is passed for examination, proving that it is absolutely intact and is the genuine article The egg is marked for identification at the bottom and then struck a blow with a small hammer. An examined probe is dipped down into the contents of the egg, the ring removed, washed and returned to its owner. It will be observed that the hammer itself serves to drive the ring into the egg under cover of the blow. This is one of the most unique tricks which has as yet been produced.



A hammer provided with a spring and catch precipitates a borrowed ring into the interior of an unprepared egg as the diagram indicates.

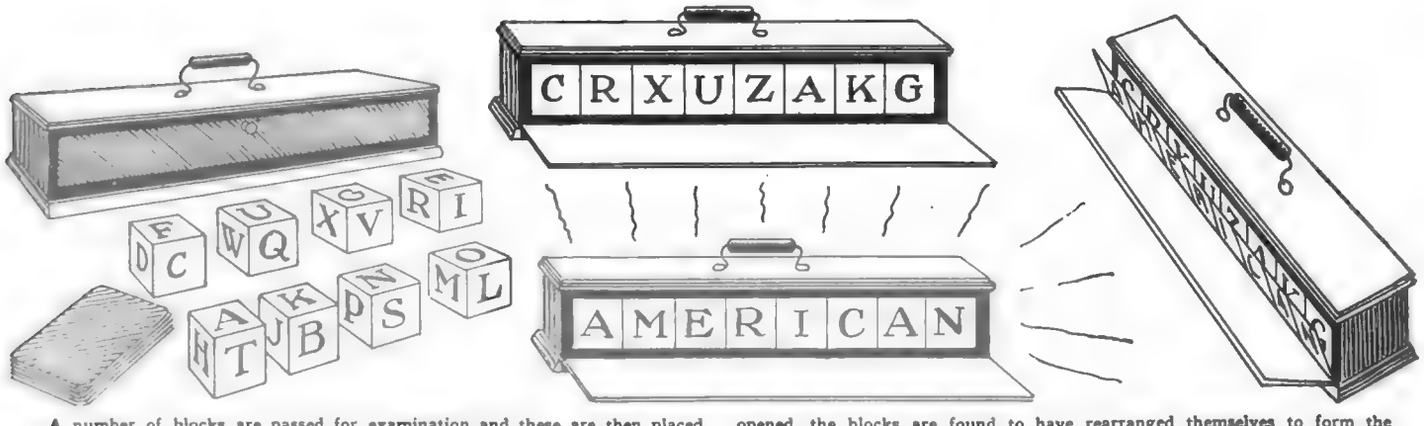
The Obedient Ball



By the aid of a string passing between the hands as the diagram indicates, a ball may be made to raise vertically in the air.

A WOODEN croquet ball has a small hole drilled clear through it through which a string passes. This string is free at one end and is opened in the form of a loop at the other and again affixed to the ball itself as the diagram indicates. The performer on picking up the ball, passes his hand through the loop and affixes the other end of the string to his left hand. By bringing the hands apart, the ball may be made to rise and again on bringing them closer together, the ball will be found to settle into the left hand.

The Puzzle Blocks

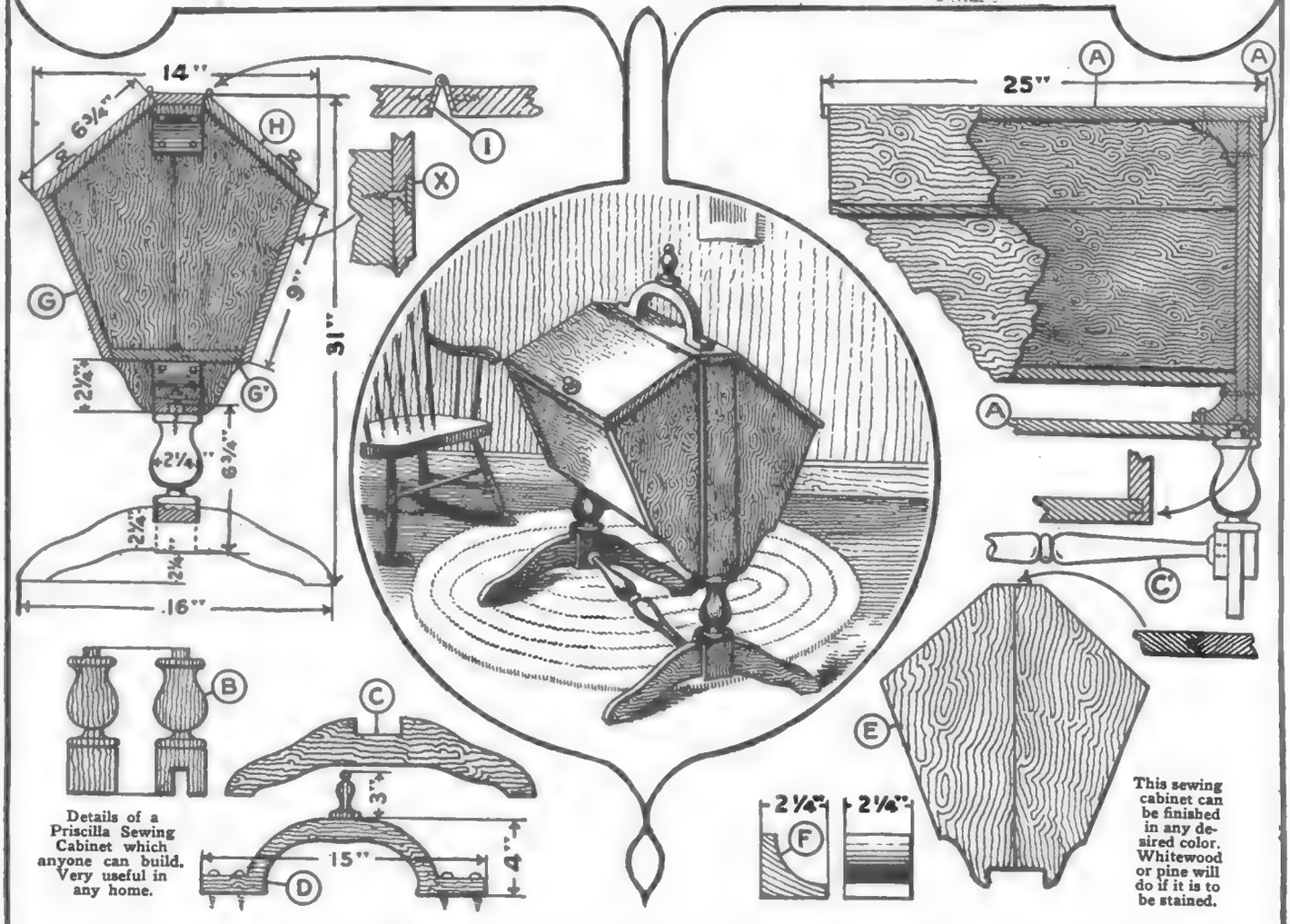


A number of blocks are passed for examination and these are then placed in a wooden case so as to form no word in particular. A member of the audience, generally a "plant" is asked for a word with eight letters. He thinks of the word American, the cover of the box is closed and when opened, the blocks are found to have rearranged themselves to form the word. The stunt is produced through the agency of a thin metal flap which covers the blocks. This is indicated at the extreme right of our drawing. The cover may be closed and blocks removed for demonstration.

Home Mechanics

A Priscilla Sewing Cabinet

By W. M. BUTTERFIELD



Details of a Priscilla Sewing Cabinet which anyone can build. Very useful in any home.

This sewing cabinet can be finished in any desired color. Whitewood or pine will do if it is to be stained.

THE Priscilla sewing cabinet has from its inception been a standard, but, like all other furniture of our early colonial days, it has had its periods of obscurity. Today, in common with other favorites, it is again a frequent and popular offering in furniture sales.

This cabinet is found both in antique shops and on the floors of up-to-date modern furniture dealers where many "Early Period" styles are reproduced perfectly by modern manufacturers to all outward appearances. The methods of construction are, of course, different, and the construction of the cabinet shown on this page is not the same as the shop-made article. It is designed for the home-mechanic methods of construction. It will be found easily made, strong and quite as true to the original Priscilla as any cabinet that followed it in early days or at the present time. The wood used in the original may have been maple or it may not have been, at any rate, maple will be a fine lumber to use in the construction of our cabinet. The sizes, thicknesses and lengths of the lumber required is as follows:

19	feet	10"	lumber	¾" thick
9	"	2½"	"	⅞" "
3	"	4¾"	"	1" "
2	"	4"	"	1" "
3	"		"	2¼ square
3	"		"	1½ "

The ¾-inch lumber is for the box part of the cabinet, making the ends (E), the sides (G), the lids (H) and the bottom (G¹). The ⅞-inch lumber is for the frame (AAA); the 1 inch for the feet (C), and the handle (D); the 2¼ inch for the legs (B); and 1½ inch for the brace (C¹). The frame (A) is constructed as shown in our diagram and is 25 inches long at the top, 24 inches long at the bottom and 22½ inches wide (high)—the two end pieces being 21⅜ inches long. The four corners are joined as illustrated, glue being used to hold the wood. Have the frame perfectly square in the corners when the glue is dry.

The end pieces (E) are made of two pieces of the ¾-inch lumber glued together as shown. Each piece when it is completed is 21⅛ inches long, 13 ¾ inches wide at the angle, 9 inches wide at the bottom of the box, and cut out as illustrated below this point with 2¼-inch terminals at both top and bottom.

The legs (B) are 9 inches long, with 2¼ inches for the square part forming the bottom and 4½ inches for the turned part and dowel at the top. The dowel is ½ inch long and 1 inch in diameter. It is secured with glue and a screw and washer in the bottom of frame (A) as illustrated. The feet are secured with glue in the slotted part of the legs. The legs and feet are braced with the turned spindle (C¹). This spindle is 1¼-inch in diameter at the ends and middle and is secured with a dowel. It is 19½ inches between dowels or 20½ inches long over all. The legs are turned from the 2¼-inch square lumber, the brace from the 1½-inch stock.

Four corner pieces (F) are used to stiffen the frame. They are 2¼ inches square, shaped as shown, and are secured with glue and four screws driven through (E) to frame (A) at top and lower outside ends (see illustration) and to the frame (A) on the inside ends. These four corner pieces are cut from the 2¼-inch stock.

The sides (G) are 9 inches wide, 21¾ inches long and are secured to the end pieces (E) with four screws at each end and with glue (see X). Each screw is covered with wood as shown. The method of putting in these screws is as follows: first countersink the screw hole by using a ½-inch bit for the wood cap, then use an ordinary countersink for the screw head ending with the bit for the shank of the screw. When the screws are driven home use a ½-inch spindle of wood (maple) for cap stock, saw into thin disks, then glue disks in the counter sunk holes over the head of the screws. When dry finish down with plane or sandpaper. The disks must fit the countersunk holes perfectly and tightly.

There are two hinged lids (H) each 9 inches wide and 21¾ inches long. These are secured with 1-inch hinges placed as shown, with a lift button for each lid. For safety against warping, two cleats for each lid are sometimes placed on the underside of the lids. If this is done the cleats should be 2 inches shorter than the width of the lids—say

(*Continued on page* 838)

The Chemical Reactions of the Alcohols

By DR. E. BADE

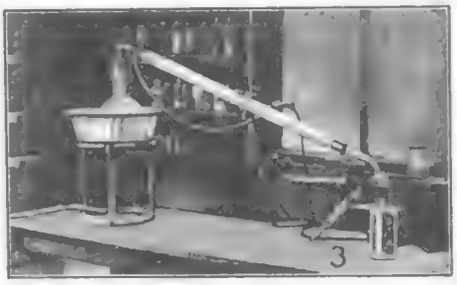
Make a calcium chloride tube by taking a short wide tube, rounding its ends in a Bunsen burner flame and, after fitting a stopper with a hole, place a wad of glass wool close to the stopper. Then add dry calcium chloride, add a second wad of glass wool on top of the salt, and fit another stopper with a hole to the free end of the tube.

THE alcohols, of which there are a number, which may be looked upon as the oxygen derivatives of the paraffins, are colorless and neutral. Those having few carbon atoms are liquids and those having many are solids. The former are mobile liquids mixable in all proportions with water, the middle members are more oily and do not mix in all proportions with water while the higher members, which are solid and odorless, in some cases do not mix with water, and are greasy to the touch like paraffin wax.

Methyl alcohol is the lowest member of this group and, since it is prepared by the distillation of wood, it has received the name of wood alcohol. It is poisonous and is extensively used to denature ethyl or grain alcohol for certain industrial uses. Wood alcohol itself is much used for making formaldehyde, dyes, etc., and in preparing various varnishes.

Metallic sodium attacks the alcohols forming an alcoholate or alkoxide. The best known are sodium methoxide and sodium ethoxide both being employed in the syntheses of organic compounds. When a piece of sodium is thrown in a beaker containing wood alcohol, a vigorous effervescence takes place, but the reaction does not produce sufficient heat to cause combustion. When the sodium has disappeared, the solution is evaporated on a water bath to dryness. A white solid remains which readily takes up water from the air, and, at the same time, is decomposed by the water, forming caustic soda and wood alcohol. In order to preserve the sodium methoxide, it must be kept in a tightly stoppered bottle. Also this compound must be prepared with pure wood alcohol.

A great many experiments are carried out with alcohol and the type used for external purposes may be employed to advantage in all cases. Now, although the alcohols are neutral compounds, they do react quite similarly to caustic alkalies, with acids, to form compounds called esters. Then, too, under special treatment, other compounds are formed, so it is well to have a small supply of the ethyl or grain alcohol, marked for external use only, at hand. It will be used quite frequently.



Distilling the water-free alcohol under anhydrous conditions by placing a two-hole cork into the receiver, one hole of which leads to the condenser; the other to the calcium chloride tube.

Extracting the ethyl alcohol from the lime with an upright condenser to which a calcium chloride tube is attached.

This type of ethyl alcohol is only 95% alcohol, the rest is water together with a few denaturants making it unfit for drinking but still it is useful for laboratory work. At times it is quite essential to use alcohol free from all traces of water. Simply distilling the alcohol will not give us absolute alcohol by any means, the water must be removed in other ways. The most convenient method employs burnt lime, the lime being slaked by the water in the alcohol which results in liberating the alcohol free from water. Under this condition the alcohol may be distilled by an anhydrous process. When the method is carefully followed out, water-free alcohol, known as 100%, or absolute alcohol will result.

It may be well to mention at this point that the denaturants used in making the grain alcohol unfit for drink, are of such a nature that they are *not* removed by this or any other process. Remember the poisons are still present and the alcohol is just as unfit to drink as it was in the beginning. The only thing that you have done was to remove the water which is present and undesirable in many chemical reactions.

Heat copper sulphate over a small flame until a white powder is obtained. This is used to test for water in the alcohol.

Into a one liter flask put 500 cc of ethyl alcohol. Then carefully add 250 grams of quicklime (calcium oxide) which should be in the form of small lumps but not powdered. Place the flask in a large dish of water, the bottom of which contains a handful or so of excelsior. The excelsior prevents the flask from standing on the bottom of the water-bath dish, and also provides a stand so that the flask will be held in position; then attach a reflux condenser, preferably of the bulbed type, but this is not necessary. A long straight condenser with a water jacket of course, can also be used just as effectively. But the condenser must be long so that all vapors are condensed and brought back into the tube.

The top of the condenser is provided with a calcium chloride tube to prevent moisture of the air from entering the condenser and reaching into the alcohol from which the moisture is being removed. This calcium chloride tube can be made quite easily, if none is at hand. Take a piece of glass tubing about ½ or ¾ inches in diameter or a

Adding metallic sodium to wood alcohol to make sodium alcoholate.

test tube whose bottom has been cut off and the edges rounded, and stopper one end with a cork having a hole through which a small glass tube extends. Push some glass wool into the tube so that it fills about ½ an inch of the large tube. Then add granular calcium chloride to within an inch of the end. Stopped with another plug of glass wool (absorbent cotton may also be used) and attach another cork having a small glass tube through it.

When the apparatus has been assembled, heat the water bath and boil the alcohol gently for one hour. Should the alcohol boil too vigorously, add a little cold water to the bath and slightly reduce the flame. At the end of the hour let the alcohol cool sufficiently so that it stops boiling, remove the reflux condenser and arrange a long straight condenser for distillation by thrusting a bent glass tube through a perforated cork, which fits into the neck of the flask. Attach the condenser to this neck, and attach the receiving flask to the other end of the condenser by means of a two-holed stopper. The cork should fit tight, and the second hole is provided with the calcium chloride drying tube. The change should be rapid.

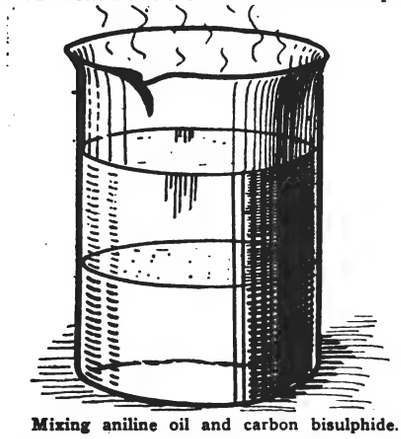
When all connections are tight distill the alcohol by heating the water bath again. Take care not to heat too rapidly at first, for the mixture in the flask bumps violently at times. Collect the first 15 cc in a small test tube and then attach the flask and distill until no more drops come over.

To test for the presence of water in the alcohol, take some copper sulphate and carefully heat it in a dish until the copper sulphate fall into a light grey, almost white, powder. Cool, and stopper in a small bottle. Take a little of the powder, place in a test tube and add two or three cc of the alcohol. Absolute alcohol will not affect the powder in an hour or so, but if a trace of water is still present, the grey powder turns back to its original blue color.

A Wonder of Organic Chemistry

By O. IVAN LEE, B.Sc., F.M.S.A.

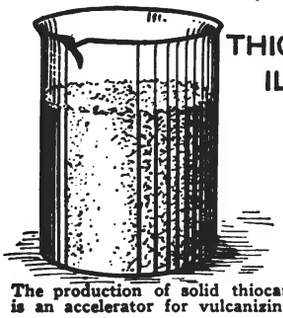
A POISONOUS evil smelling gas, a commercial rubber accelerator (of vulcanization), and chemical mustard oil, all produced from aniline oil and carbon bisulphide.



Mixing aniline oil and carbon bisulphide.

Mix *equal volumes* of carbon bisulphide (in which has been dissolved a pinch of flowers of sulfur) and aniline oil in a glass or beaker and allow to stand *outdoors* overnight.

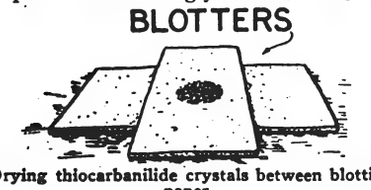
Caution! Carbon bisulphide is very inflammable. Do not allow even a lighted cigarette to come in its vicinity.



The production of solid thiocarbanilide, which is an accelerator for vulcanizing India rubber.

During the night a poisonous gas (hydrogen sulphide) having the odor of decayed eggs, is evolved, and in the morning the contents of the glass will be found solidified by white glistening pearly plates and crystals of *thiocarbanilide*, one of the most widely used accelerators for vulcanization of rubber.

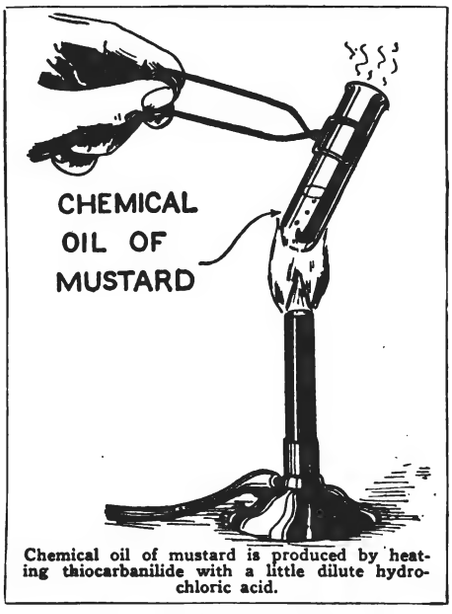
Remove some of the soft white crystals and press them strongly between two clean



Drying thiocarbanilide crystals between blotting paper.

pieces of white blotting paper; this will absorb most of the (uncombined) aniline oil and carbon bisulphide remaining. Then air them awhile to further assist the drying.

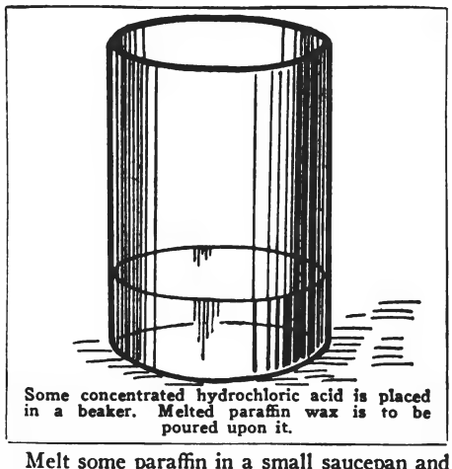
Heat (but not to boiling) the dry white crystals of thiocarbanilide with a little diluted hydrochloric acid. The crystals will disappear, heavy oily yellow drops remaining (add a little more acid if necessary). If the solution is then boiled, a powerful and penetrating odor of mustard will be perceived since the chemical oil of mustard which has been formed, is volatile.



Chemical oil of mustard is produced by heating thiocarbanilide with a little dilute hydrochloric acid.

A CHEMICAL SMOKE BOMB

Into a thin glass vessel, carefully pour about one inch of concentrated hydrochloric acid, avoiding spattering any drops on the sides of the glass.

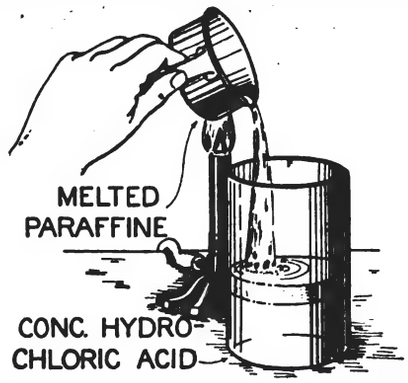


Some concentrated hydrochloric acid is placed in a beaker. Melted paraffin wax is to be poured upon it.

Melt some paraffin in a small saucepan and slowly and carefully pour about ¼ inch of the melted wax on the surface of the acid in the glass where it will soon solidify, sealing the acid underneath. Blow out any acid vapors which may remain.

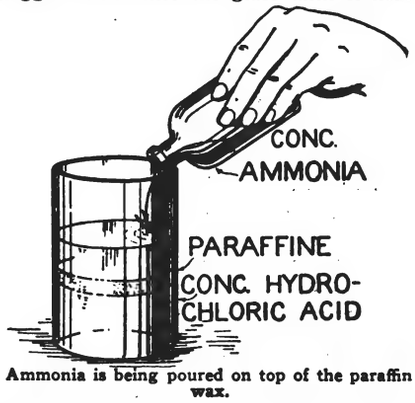
Now pour about ½ inch of concentrated ammonia water on the paraffin wax.

Fashion a "trigger stick" by nailing a broom handle about six inches long to the



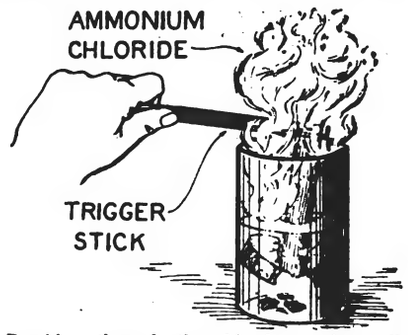
The experimenter is pouring the melted paraffin wax on top of the hydrochloric acid.

end of a stick like a yard stick. Now place the glass vessel carefully on a firm place on the ground outdoors, lower the head of the "trigger stick" into the glass until it nearly

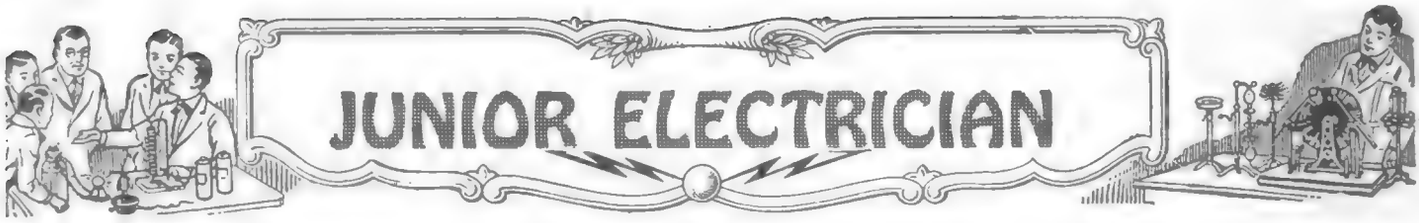


Ammonia is being poured on top of the paraffin wax.

touches the center of the wax, and then, give a quick downward push. Instantly, a huge billowy cloud of white smoke (ammonium chloride) will be projected upwards without flame or sound.—O. IVAN LEE.



Breaking through the thin layer of paraffin brings the hydrochloric acid and ammonia together so as to produce ammonium chloride as a thick white smoke.



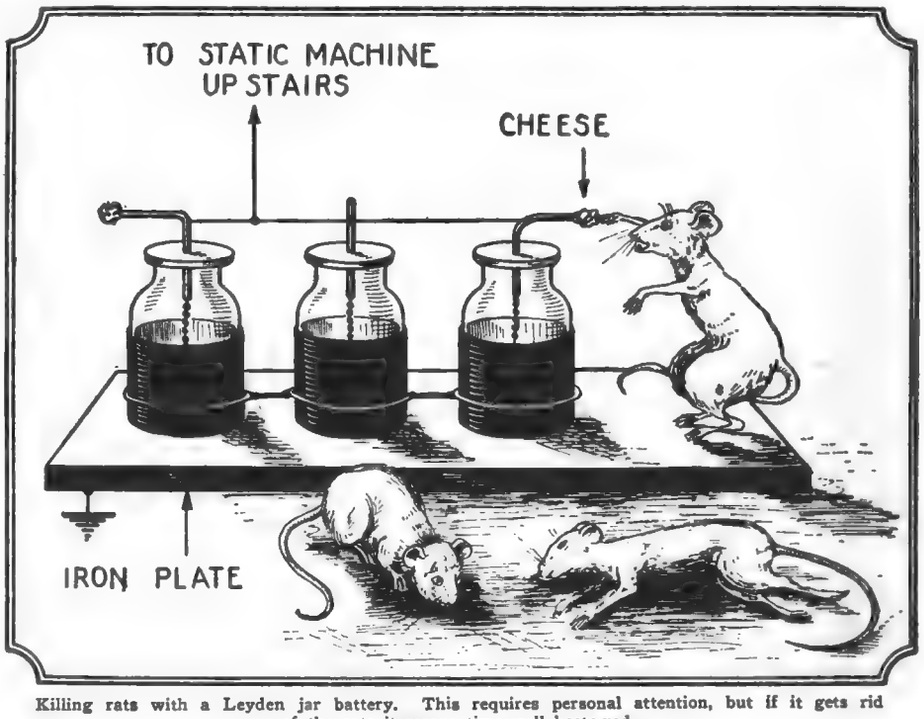
Rat Destroyer

Some time ago a boy made a connected battery of three Leyden jars. This he connected and placed upon a large iron plate. A bait was so arranged that when a rat attempted to take it, a current would pass through him, killing him instantly.

Wires were extended from an electric machine in the upper room to the jars in the cellar, as often as the boy heard a rat squeak, he turned on the juice.

The first time he put the machine in operation he slaughtered 25 rats in the space of three hours, and in two days the cellar, which had been infested, was clear of them.

Contributed by Nora Bell Gluno.



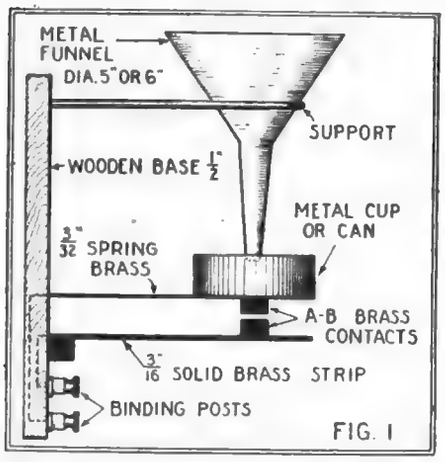
Killing rats with a Leyden jar battery. This requires personal attention, but if it gets rid of the rats it means time well bestowed.

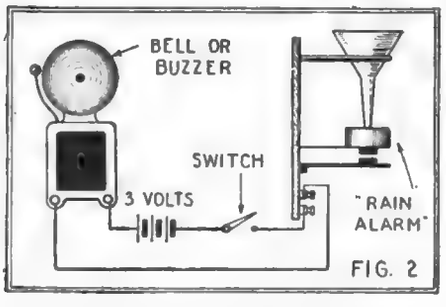
Electric Rain Alarm

The illustration shows a very simple and efficient rain alarm of rather unusually good construction. At A and B are two brass contacts, the lower one carried by a stiff brass strip, and the upper one by a very weak strip of spring brass. The brass spring carries a metal cup which must be so poised or weighted that the spring will be on the very point of descending or bending down.

Above the cup a funnel is supported; the least amount of rain falling into the funnel will reach the metal cup, bend down the spring, and bring the contacts together; this closes the circuit.

The second illustration shows a bell and battery with switch all connected; the rain alarm is outside the window. The minute rain falls, it trickles down into the cup and rings the bell. A piece of ½-inch wood carries the apparatus as shown, and this is fastened outside the window. It is well to get the funnel and contact at a little distance from the building, so that the falling of the rain will be uninfluenced by wind current occasioned by the side of the house.





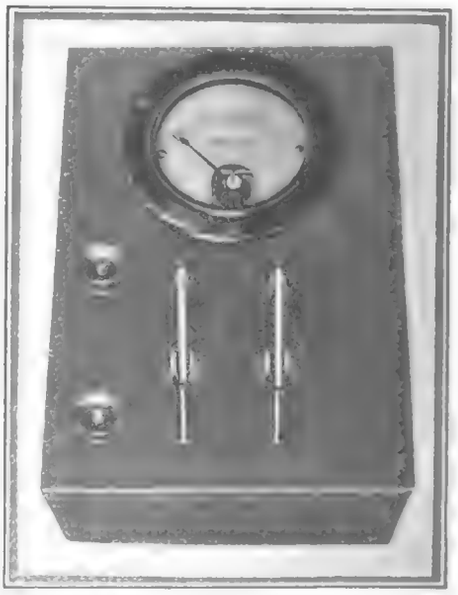
A somewhat elaborately constructed rain gauge which by the use of a large funnel and delicate spring can be made extremely sensitive so as to give the alarm for the first few drops. To make it more sensitive, it is well to coat the funnel inside with paraffin wax.

A Universal Volt-Ammeter For Direct Current

By JOSEPH LIEBOWITZ

ESSENTIALLY, the voltmeter is identical with the ammeter in construction. The difference between the two instruments lies in the fact that the moving coil of the voltmeter is connected in series with a comparatively high resistance, the value of which is dependent upon the range of voltage to be measured; in the ammeter, the moving coil is connected across or in shunt with, a relatively low resistance, the value of which depends upon the intensity of current to be measured. The resistance of the moving coil is usually the same in both instruments, its value being only a few ohms. From the above discussion it may be seen that it is quite possible to use one instrument both as a voltmeter and as an ammeter.

The first thing necessary for the construction of the universal volt-ammeter is either a voltmeter or an ammeter of the moving-coil, permanent magnet type. The instrument should be of reliable make, such as Weston or Jewell. The meter shown in the photograph is a Jewell 1.5 ampere range ammeter, pattern No. 33. This is a rather small instrument, measuring 3.5 inches in diameter, and serves the purpose for a portable meter. If greater accuracy and ease of reading are desired, a larger instrument should be used. If the instrument is an ammeter, very carefully remove the shunt, and if a voltmeter, remove the resistance unit. It is now necessary to make up a set of shunts and resistances (in addition to the shunt or resistance already removed) to cover the desired ranges of current and voltage. If the scale is divided into ten or one hundred divisions, it will be well to have the ammeter ranges in multiples of ten, such as 0.1, 1.0 and 10.0, and similarly, the voltmeter ranges, 0.1, 1.0, 10.0, 100.0 and 1000.0. If the scale is divided into fifteen parts or a multiple thereof, the volt and ampere ranges should be made in multiples of fifteen.



Reproduction of a photograph of the Jewell meter, pattern No. 33, recommended for the experiments in calibration.

In order to properly calibrate the instrument, a reference standard is necessary. The apparatus necessary for the complete cali-

bration test is as follows: one multi-range ammeter, one multi-range voltmeter, both these instruments covering the ranges of pressure and current desired, manganin wire or strip (for the ammeter shunts), several thousand ohms of nichrome, German silver or other resistance wire (for the voltmeter resistances), one load resistance box (to give a variation of current through the ammeter), and a source of variable electromotive force. The latter may be obtained by means of a potentiometer connected across

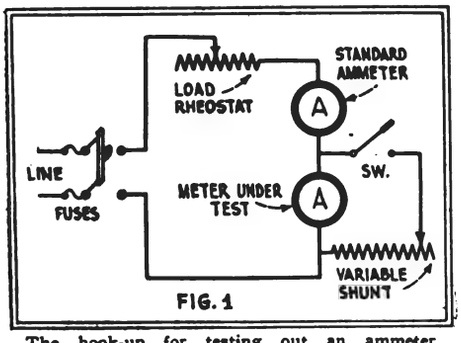


FIG. 1

The hook-up for testing out an ammeter against the standard instrument, but here you have to be very sure of your standard. It will be observed that the ammeter is tested in series therewith.

a source of EMF. The connections for the ammeter calibration are shown in Fig. 1. The length of manganin wire or strip connected across the ammeter coil is varied until the instrument reads exactly the same as the standard instrument over the entire scale. Having determined the proper size of shunt for one range of current, the shunt is labeled and carefully put aside. The shunts for the other ranges are determined in a similar manner. To avoid burning out the coil of the meter under test, always open the line switch (see Fig. 1) before making any adjustments on the shunt. Also note switch in the shunt circuit, which is closed at all times. This switch will be used as explained later.

For the voltmeter test, follow Fig. 2 carefully. The potentiometer used should have a sufficient current-carrying capacity so that it will not overheat when connected across the source of current, which may be the house lighting system or a set of storage batteries or dry cells of sufficiently high voltage. The amount of resistance wire inserted in series with the meter under test is varied until the instrument reads exactly the same as the standard voltmeter over the entire scale. The series resistance should be sufficiently high to prevent burning out the

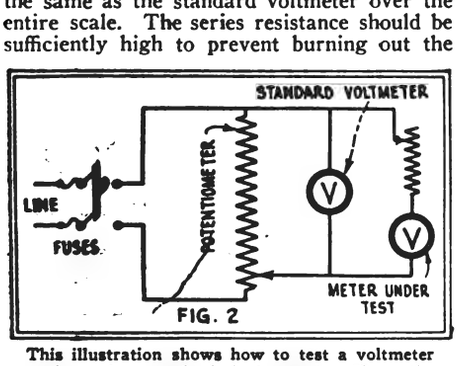


FIG. 2

This illustration shows how to test a voltmeter against the standard instrument. Here the connections are in parallel, and by varying the resistances, a good range of factors is obtained.

moving coil of the meter under test. For example, assume as a safe value of resistance one hundred ohms per volt. This will give 100 ohms for the one-volt range, 1,000 ohms for the ten-volt range, and 10,000 ohms for one hundred-volt range. *These are not necessarily the exact values to be actually used ultimately.* They are merely given as safe values of resistance with which to start the tests. In making up the voltmeter resistances, it is best to determine first the resistance necessary for the lowest range. To this resistance is added an additional resistance, the two together making up the resistance necessary for the next higher range. A similar procedure is followed for the remaining resistances. In this manner the highest voltage range will use all of the resistances, and a minimum number of resistance units will be required.

Manganin wire or strip is recommended to be used for the shunts, because its temperature coefficient of resistance is extremely small, that is, its resistance does not increase or decrease very appreciably with temperature changes. However, if it is not possible to obtain manganin, ordinary double cotton-covered copper wire may be used. The procedure for obtaining the proper size of shunt is exactly what was given in the case of the manganin. In order to avoid using too great a length of wire for the shunt, a fairly small size of wire may be used, say number 18 or 20 B. & S. gauge. The wire shunts should be wound up in non-inductive coils, as shown in Fig. 3. The wire may be wound either in the form of a pancake or in a helical shape. In either case it is thoroughly taped after winding. If copper wire is used for the shunts, an external short-circuiting switch should be used with the ammeter, opened only while taking a reading.

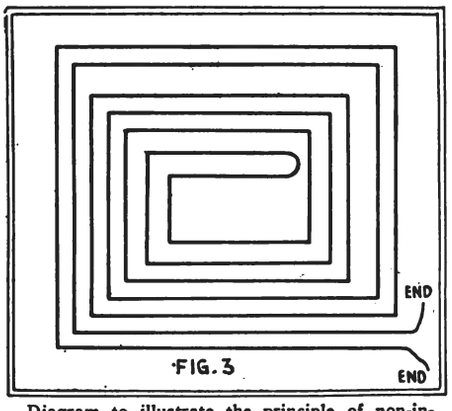


FIG. 3

Diagram to illustrate the principle of non-inductive winding so as to get a resistance which will not create a field.

The resistances to be used in connection with the voltmeter are also wound non-inductively, upon a strip of mica or bakelite. Taps are taken off for the various ranges, as Fig. 4 indicates, and the unit is shellacked and taped. The various taps are connected to the proper binding posts, as will be described later. The reason for winding the shunt wires and voltmeter resistances non-inductively is to eliminate any electro-magnetic effects which would affect the movement of the meter coils, and thus give rise to inaccurate readings.

Having carefully made up the necessary resistances and shunts, we are now ready to mount the meter and other essential parts upon a panel, in order to make the instrument portable. A bakelite or hard rubber panel is selected of such a size that the meter, binding posts and switches may be conveniently mounted thereon. If possible, a flush-mounting, panel-type meter should be used, as this type does not project very far beyond the panel when mounted, and also makes a very neat, "commercial" appearance for a portable instrument. The switches used for throwing the shunts into the circuit (see Fig. 5) are single pole, single throw knife switches of ten ampere capacity. The voltmeter binding posts are of hard rubber or bakelite, but the ammeter terminals should be nickel-plated brass, and of large proportions, in order that they may carry the current without undue heating. If hard rubber posts were used on the ammeter side they would soon become distorted in shape due to the heat, especially when an arc is formed at the meter terminals due to one of the wires being accidentally pulled from a binding post. Connections to the binding post should be as heavy as possible, in order that no extra resistance may be introduced. The reason for using the knife switch in series with the shunt in Fig. 1 becomes apparent when Fig. 5 is referred to. The same, or a similar switch, is used for throwing the shunt in or out of the circuit. The resistance of the shunt is therefore equal to the resistance of the shunt wire, plus the resist-

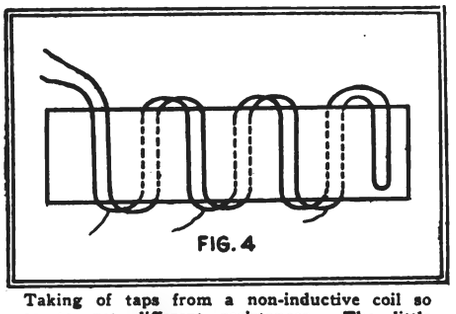


FIG. 4

Taking of taps from a non-inductive coil so as to get different resistances. The little dashes indicate the positions of taps not the connections.

ance of the connecting wires (which should be as low as possible,) plus the resistance of the switch, in each case. As many switches are used as the number of shunts.

To use the instrument as an ammeter, make connections to the ammeter terminals, keeping all shunt-switches closed. If the needle does not go off scale, open all shunt-switches except the one corresponding to the highest range. Note the reading. If a lower-range scale is desired, throw in the shunt-switch corresponding to that range, and then open the switch that was previously closed. At no time must all of the shunt-switches be open when the instrument is used as an ammeter.

If it is desired to use the instrument as a voltmeter open all shunt-switches, connect leads between the common voltmeter terminal and the terminal corresponding to the range desired.

For a Jewell meter, use resistance and shunt values about as shown.

Series resistance for 150-volt range, 3,740 ohms.

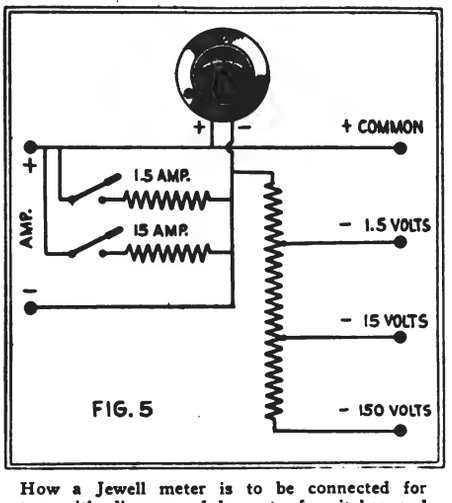


FIG. 5

How a Jewell meter is to be connected for test with diagram of lay-out of switches and resistance coils including the potentiometer.

Series resistance for 15-volt range, 364 ohms.

Series resistance for 1.5-volt range, 33 ohms.

Resistance of meter coil, 5.37 ohms.

Shunt for 1.5 amp. range, 11 ft. No. 22 DCC copper wire (approximately).

Shunt for 15 amp. range, 6 ft. No. 20 DCC copper wire (approximately).

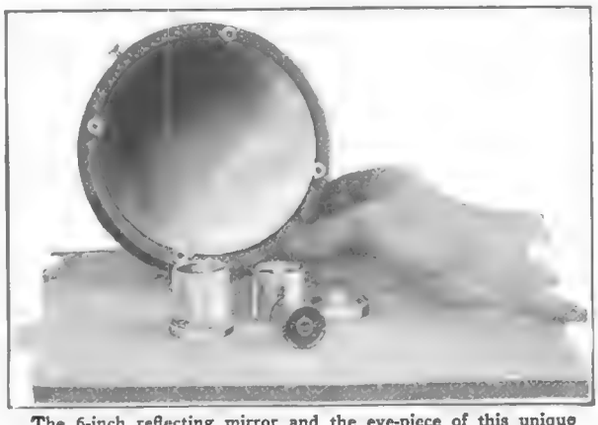
THE CONSTRUCTOR

Building Your Own Telescope

MANY requests have come to us for the construction of a telescope which will be powerful enough to show the mountains on the moon and those other wonderful splendors of the heavens which we read about, but which telescope must be within the scope of the average experimenter's pocket-book. The construction of the instrument given in the accompanying article has reduced the cost of building a very powerful telescope to such a point that the average layman can easily afford one. Every effort has been made to simplify the apparatus and to make a mount universally applicable. Al-

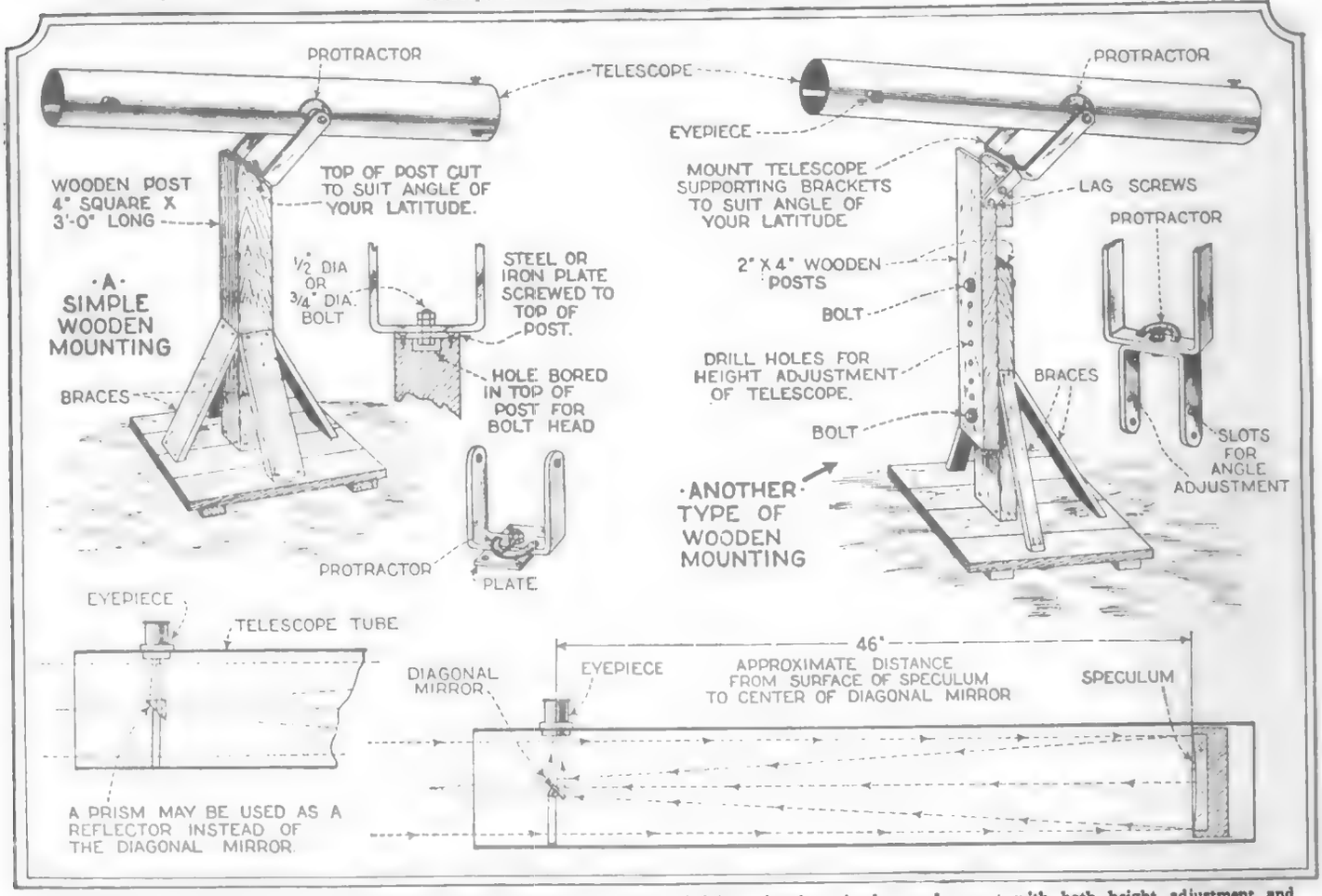
(*Continued on page* 859)

A photograph of the telescope tube constructed by the editors.



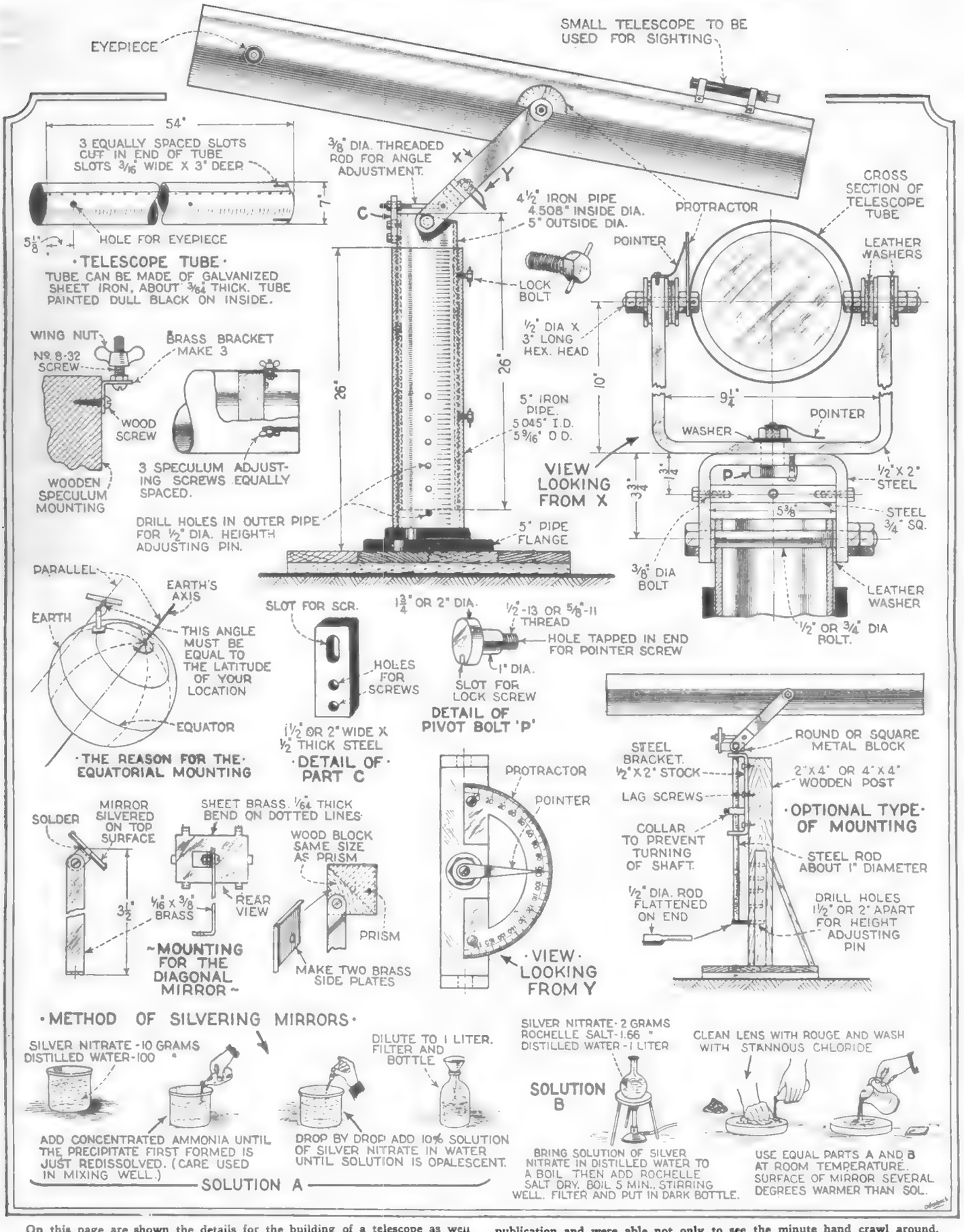
The 6-inch reflecting mirror and the eye-piece of this unique telescope is here shown.—Courtesy Ernest W. Blandin.

The finished telescope as built in The S. & I. Laboratories.



The diagrams here show how two very simple forms of equatorial mountings can be constructed. In the diagrams at the left, the simplest style of non-adjustable wood mount is indicated. This type is fixed as regards height. Another simple wood mount with both height adjustment and equatorial angle adjustment in addition to other necessary movements is indicated at the right.

Constructional Details of Telescope


EYEPIECE
SMALL TELESCOPE TO BE USED FOR SIGHTING
54"
3 EQUALLY SPACED SLOTS CUT IN END OF TUBE SLOTS 3/16" WIDE X 3" DEEP
7"
5 1/8"
HOLE FOR EYEPIECE
·TELESCOPE TUBE·
TUBE CAN BE MADE OF GALVANIZED SHEET IRON, ABOUT 3/64" THICK. TUBE PAINTED DULL BLACK ON INSIDE.
3/8" DIA. THREADED ROD FOR ANGLE ADJUSTMENT.
X
Y
C
4 1/2" IRON PIPE 4.508" INSIDE DIA. 5" OUTSIDE DIA.
LOCK BOLT
1/2" DIA X 3" LONG HEX. HEAD
26"
26"
5" IRON PIPE. 5.045" I.D. 5 9/16" O.D.
DRILL HOLES IN OUTER PIPE FOR 1/2" DIA. HEIGHTH ADJUSTING PIN.
5" PIPE FLANGE
PROTRACTOR
CROSS SECTION OF TELESCOPE TUBE
POINTER
LEATHER WASHERS
10"
9 1/4"
POINTER
WASHER
VIEW LOOKING FROM X
P
3 3/4"
3 3/4"
1/2" X 2" STEEL
5 3/8"
STEEL 3/4" SQ.
3/8" DIA BOLT
LEATHER WASHER
1/2" OR 3/4" DIA BOLT.
WING NUT
No. 8-32 SCREW
WOOD SCREW
WOODEN SPECULUM MOUNTING
BRASS BRACKET MAKE 3
3 SPECULUM ADJUSTING SCREWS EQUALLY SPACED.
PARALLEL
EARTH'S AXIS
EARTH
THIS ANGLE MUST BE EQUAL TO THE LATITUDE OF YOUR LOCATION
EQUATOR
·THE REASON FOR THE· EQUATORIAL MOUNTING
SLOT FOR SCR.
1 3/4" OR 2" DIA.
1/2"-13 OR 5/8"-11 THREAD
HOLE TAPPED IN END FOR POINTER SCREW
HOLES FOR SCREWS
1" DIA.
SLOT FOR LOCK SCREW
1 1/2" OR 2" WIDE X 1/2" THICK STEEL
·DETAIL OF· PART C
DETAIL OF PIVOT BOLT 'P'
PROTRACTOR
POINTER
·VIEW· LOOKING FROM Y
ROUND OR SQUARE METAL BLOCK
STEEL BRACKET. 1/2" X 2" STOCK
2" X 4" OR 4" X 4" WOODEN POST
LAG SCREWS
·OPTIONAL TYPE· OF MOUNTING
COLLAR TO PREVENT TURNING OF SHAFT.
STEEL ROD ABOUT 1" DIAMETER
1/2" DIA. ROD FLATTENED ON END
DRILL HOLES 1 1/2" OR 2" APART FOR HEIGHT ADJUSTING PIN
SOLDER
MIRROR SILVERED ON TOP SURFACE
SHEET BRASS. 1/64" THICK BEND ON DOTTED LINES
WOOD BLOCK SAME SIZE AS PRISM
3 1/2"
1/16" X 3/8" BRASS
REAR VIEW
PRISM
MAKE TWO BRASS SIDE PLATES
~MOUNTING FOR THE DIAGONAL MIRROR~
·METHOD OF SILVERING MIRRORS·
SILVER NITRATE - 10 GRAMS
DISTILLED WATER - 100
ADD CONCENTRATED AMMONIA UNTIL THE PRECIPITATE FIRST FORMED IS JUST REDISSOLVED. (CARE USED IN MIXING WELL.)
DILUTE TO 1 LITER. FILTER AND BOTTLE
DROP BY DROP ADD 10% SOLUTION OF SILVER NITRATE IN WATER UNTIL SOLUTION IS OPALESCENT.
SOLUTION A
SILVER NITRATE - 2 GRAMS
ROCHELLE SALT - 1.66 "
DISTILLED WATER - 1 LITER
SOLUTION B
BRING SOLUTION OF SILVER NITRATE IN DISTILLED WATER TO A BOIL. THEN ADD ROCHELLE SALT DRY. BOIL 5 MIN., STIRRING WELL. FILTER AND PUT IN DARK BOTTLE.
CLEAN LENS WITH ROUGE AND WASH WITH STANNOUS CHLORIDE
USE EQUAL PARTS A AND B AT ROOM TEMPERATURE. SURFACE OF MIRROR SEVERAL DEGREES WARMER THAN SOL.

On this page are shown the details for the building of a telescope as well as suggestions for the making of the mirror of the telescope. This construction was effected from material easily obtainable and the telescope was so arranged that it could be used for observing the heavens or the landscape miles away from the user. One will be astounded to note the remarkable power which this telescope has. With it the editors have observed the hands on a clock four miles from the editorial offices of this publication and were able not only to see the minute hand crawl around, but were even able to discern a small flag hung in the window of the building on which the clock appears. News-print paper can easily be read with this telescope at a distance of at least a city block. For astronomical observations this telescope has no equal for the price and is better than many costing five times as much. Jupiter's moons and Saturn's rings can be readily seen.

Blueprints of this telescope will be furnished for $1.00 by the Model Department.

How to Read Shop Blueprints

IN the October number we described with special illustrations how to read building blueprints, an article which everyone interested in building their own homes should certainly read. We had so many requests for further articles on blueprint reading that we have prepared the present elementary article on the reading of shop blueprints used in building machinery of all kinds. The editors are at work on a second article to follow this one which will take up the more elaborate shop blueprints, and this article will appear in an early number.

The drawing on the opposite page prepared by the chief draughtsman of the magazine staff, Mr. J. F. Odenbach, gives in tabloid form the principal representations of screws and various materials used in building machinery, and which are to be found on the average shop blueprint or working drawing.

There are a great number of books on machine shop work and shop drawings which the student of this subject will do well to procure or else obtain from his local library. The subject of shop drawings and the detailing of machine parts is a very fascinating one, and the study of these drawings and how to make them forms the real ground-work of every engineer.

Referring to the drawing on the opposite page we see that full lines indicate outside surfaces or edges in most cases. Thin full lines are used a great deal by draughtsmen for indicating dimensions or centers where holes are to be drilled or tapped. Main center lines are indicated usually by dot and dash representation, shown at A in the drawing.

At Fig. B we see how the various materials used in machine construction are represented, such as cast iron, steel, wrought iron, brass, wood, rubber, etc. Usually, owing to the fact that there is no universal hard and fast rule as to how various materials should be represented by draughtsmen, every well drawn blueprint or tracing should either have a key with proper labels indicating what each part is to be made of, or else the name of the material used for each part should be lettered right on the part in the blueprint.

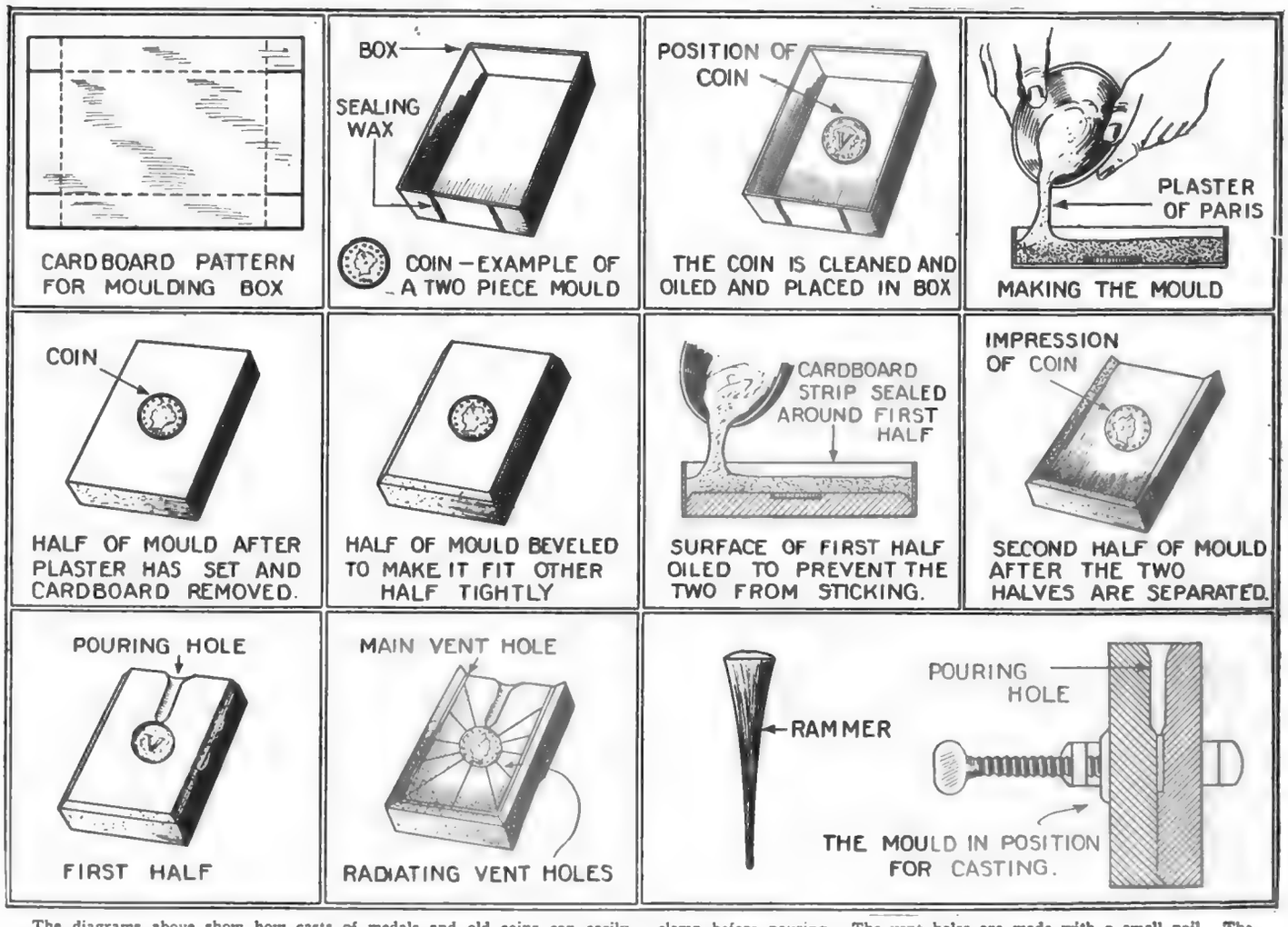
At Fig. C we see how draughtsmen represent long shafts or tubes by breaking the section at the center. This obviates the necessity of drawing a nine foot shaft or tube for instance to full scale on the drawing, which would necessitate a piece of tracing cloth or blueprint paper more than nine feet long.

The various well-known types of machine screws and bolts are shown at Fig. D, such as cap screws and both round and flat head machine screws. The difference between a machine screw and a stove bolt is that the threads on the former are actually cut by a die, while the threads on the cheap stove bolts are rolled on, and the threads are not as sharply defined, as you have probably often noticed. Stove bolts of course are never used in machine construction, except for some very cheap model perhaps made out of sheet metal, where stove bolts are used to fasten pieces of sheet metal.

At Fig. E we learn how threaded or tapped holes in metal are represented, the dotted lines of course indicating that the hole is below the surface, at which you are looking. Three methods of indicating threads on a bolt or rod are shown at F, while Fig. G shows the three principal forms of thread met with in American machine shop practice.

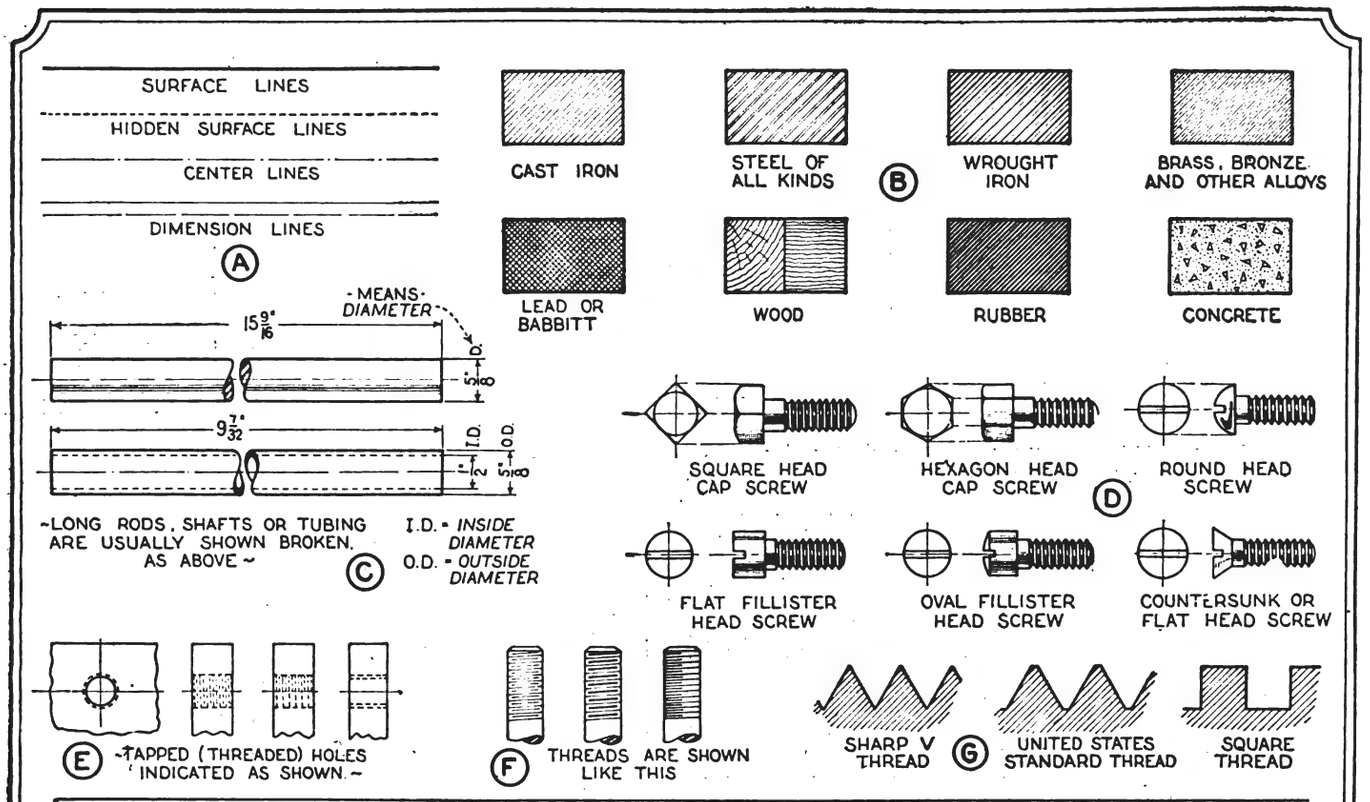
At Fig. H the student of blueprint reading may take his first important step in studying how a metal bushing is delineated by the draughtsman. Once you have become accustomed to blueprints of machine parts, you will find it quite a simple matter to tell very quickly just what a certain part will look like when finally made up. Surfaces which are to be finished by turning in a lathe or by filing, or otherwise, are marked with an F. Some draughtsmen mark the word finish on such surfaces. A pedestal for a polishing head or emery wheel is shown at I, this to be made of cast iron. An interesting drawing of a stuffing box appears at Fig. J.—H. W. Secor.

Casting with Easily Fused Metals

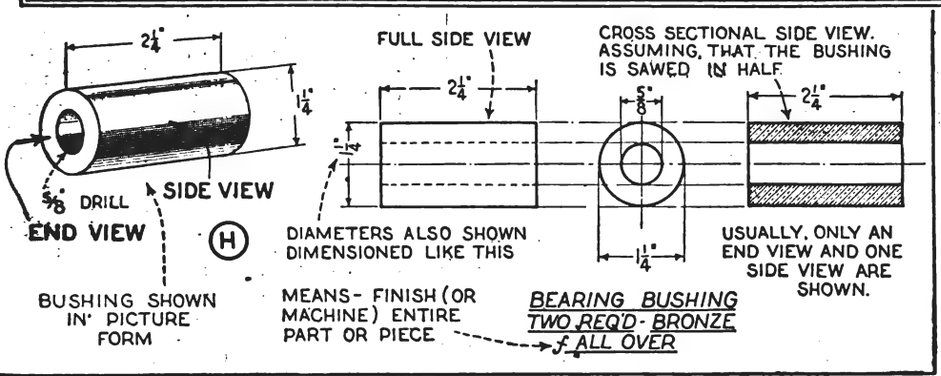

CARDBOARD PATTERN FOR MOULDING BOX
BOX
SEALING WAX
COIN—EXAMPLE OF A TWO PIECE MOULD
POSITION OF COIN
THE COIN IS CLEANED AND OILED AND PLACED IN BOX
PLASTER OF PARIS
MAKING THE MOULD
COIN
HALF OF MOULD AFTER PLASTER HAS SET AND CARDBOARD REMOVED.
HALF OF MOULD BEVELED TO MAKE IT FIT OTHER HALF TIGHTLY
CARDBOARD STRIP SEALED AROUND FIRST HALF
SURFACE OF FIRST HALF OILED TO PREVENT THE TWO FROM STICKING.
IMPRESSION OF COIN
SECOND HALF OF MOULD AFTER THE TWO HALVES ARE SEPARATED.
POURING HOLE
FIRST HALF
MAIN VENT HOLE
RADIATING VENT HOLES
RAMMER
POURING HOLE
THE MOULD IN POSITION FOR CASTING.

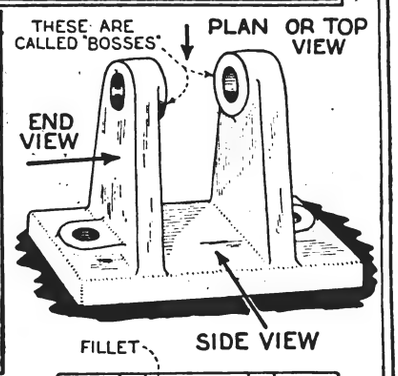
The diagrams above show how casts of medals and old coins can easily be made, the successive stages going from left to right and down the page. First half of the mould is made, the edges are beveled off and then the top half is made. A pouring hole and radiating vent holes are then cut into the top half and both portions are locked together by a clamp before pouring. The vent holes are made with a small nail. The rammer is pressed into the pouring hole as soon as the metal begins to crystallize. This system is also good for making parts of models, such as wheels, guns, etc. Type metal is an excellent material as it gives sharp castings.—Fred Robson. Drawing by Joseph Odenbach.

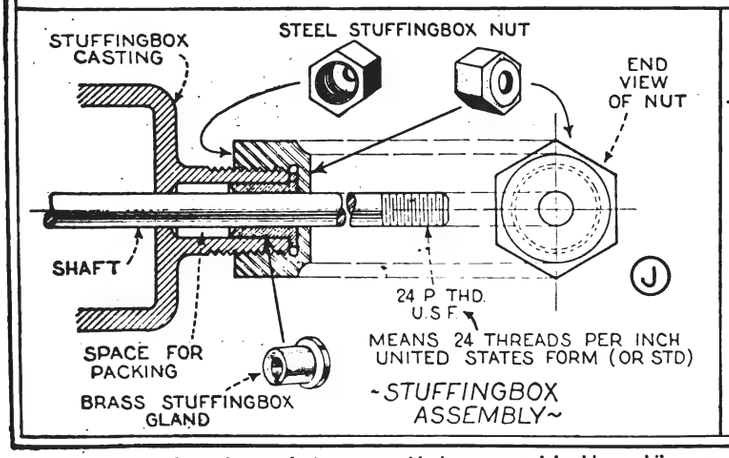
Detailing Machine Parts on Blueprints



The various kinds of lines used in making tracings for blueprints are shown at Fig. A. Full lines usually indicate surfaces or edges, while dotted lines invariably indicate parts or surfaces not seen by the observer in looking at the drawing. At Fig. B the various methods of representing the common materials used in machine work are illustrated, such as cast iron, steel and wrought iron. At Fig. C the method of illustrating long tubes or rods is shown, while at D the various well-known forms of machine screws are to be seen. At Fig. E the various methods of indicating tapped or threaded holes are shown, and three methods of indicating threads on a rod are shown at F. Three forms of threads are shown at Fig. G.


FULL SIDE VIEW
CROSS SECTIONAL SIDE VIEW. ASSUMING THAT THE BUSHING IS SAWED IN HALF
SIDE VIEW
DRILL
END VIEW
H
DIAMETERS ALSO SHOWN DIMENSIONED LIKE THIS
USUALLY, ONLY AN END VIEW AND ONE SIDE VIEW ARE SHOWN.
BUSHING SHOWN IN PICTURE FORM
MEANS - FINISH (OR MACHINE) ENTIRE PART OR PIECE
BEARING BUSHING
TWO REQ'D - BRONZE
f ALL OVER





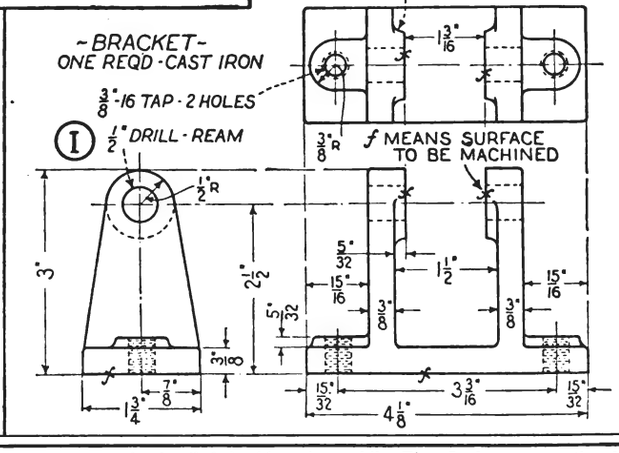


Fig. H above shows how a draftsman would show a metal bushing, while Fig. I shows the way in which a cast iron pedestal for a buffing wheel or emery stone is detailed in blueprint, while Fig. J shows a sectional blueprint view of a stuffing box. Drawing by Joseph Odenbach.

Building A Train Outfit With Toy Parts

By DR. ERNEST BADE

This photograph shows the layout of a railway made from parts in a toy girder set.

THE building of a toy model track and train comprising cars, engine, switches, bridges and tunnels with the necessary rails is not at all so very difficult provided a toy construction set is at hand. Then it just becomes a matter for the assembling of the various parts that are found in such a set, and the best part of it all is that the constructor is not limited to any special design. He may develop a system that is all his own, or, if he is so inclined, he may make a small copy of one that is already in existence.

If an Erector set is taken it is advisable, although not absolutely necessary, to take a fairly powerful motor for the electric engine, especially if a number of cars are to be pulled by the train. The electrical connections from motor to track are quite easily made. First the drive from motor to the four flanged drive wheels which are connected to a set of base plates also holding the motor firmly in place, may be made directly with gears or, which is simpler, they are connected by means of sprocket and chain. These materials are found in the construction sets and one soon becomes accustomed to their use. One terminal of the electric motor is connected to the body of the engine, the other terminal must be insulated from it either by insulating bushings or by means of an insulating fiber strip, the latter being present in the Erector set. This strip is placed on the under side of the carriage in its exact center, where it is firmly bolted in place at both sides. The center of the strip carries the contact shoe, which is a bent piece of brass as shown in the drawing, having a hole at the top. Here a bolt is fastened, which holds a wire which runs to the free pole of the motor. The contact shoe acts by its weight and presses on the third rail at all times, and it is free to move up or down between guides for a distance of slightly more than ¾ of an inch.

The tracks themselves are made with wooden ties and metal strips for rails. The ties are strips of wood ½ by ¾ of an inch cut into five-inch lengths. The distance between outside tracks was taken as 3½ inches, although any other distance may be chosen. At these distances saw cuts are placed about half way through the tie on its narrow side. Into these cuts the metal strips, which are to be used as tracks, are placed. The third rail, in this model, was made in the center of the track and since wood is an insulator for the small current used, no other insulation need be provided. It is, of course, also possible to have an outside third rail connection.

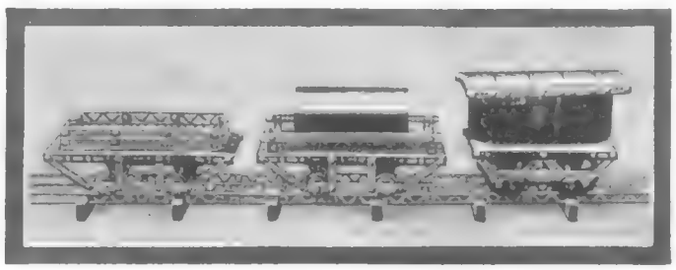
Two ties are sufficient for one foot length of track, and, since three metal strips are used, one being the third rail, the tracks become very stiff and will not move out of place, even when making the sharpest curves. Each foot section need only be bolted together to make a firm track.

The construction of the switch can be seen from the illustration. When the switch is thrown, the semaphores show a clear or blocked track, as the case may be, for the arms of the semaphores are directly connected to the switch arm which throws the switch from the main track to the siding.

Naturally a crane or two should also be present for the easy loading of the freight cars. These cranes should be so made that they not only will lift the material from truck or ground platform, but will also revolve so that the trains may be loaded directly by just turning the beam of the crane with its hoist crank.

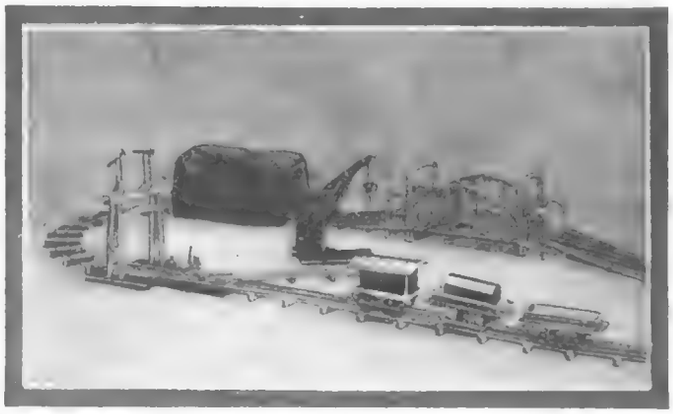
No railroad system is complete without a tunnel and this must be made separately using, as materjal, an old box or two and some old bags. First cut two similar pieces of wood in the form of an inverted U for the ends of the tunnel. Nail two strips of wood, the length of the finished tunnel and the height of the sides to the legs. Then attach some straight pieces of wood the length of the tunnel on its top and nail on some bags as a cover. To make the tunnel appear rocky, ball up some old papers and place under the bags. When the tunnel is covered with old cloth bags, both inside and out, paint them with dilute glue solution. Let dry. Paint again, dry, and repeat. After the third coat of glue the cloth will be quite stiff. Brush on another coat of glue, sprinkle the still moist glue with a little sand, ground earth colors of various shades, and a little more sand. The earth colors may also be mixed, in separate dishes, with the glue. The final result is the same.

Then, too, a bridge should not be lacking. Any type or kind may be built to suit the fancy of the constructor and even the small or larger and largest bridges in existence today may be successfully copied as models. It is thus possible to gain quite an education by assembling these toy girders.

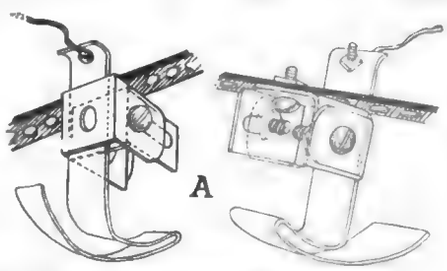


The photograph at the left shows a locomotive and two cars, the construction of which is described in the accompanying article.

The photo below gives another view of the model railway layout in which tracks, switches, bridges, signals, and the locomotive and cars are all built from parts found in a toy construction outfit.

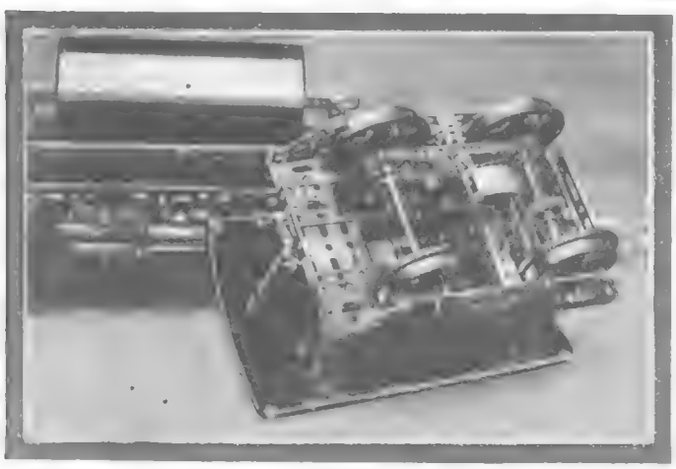


How a typical railroad bridge can be made.



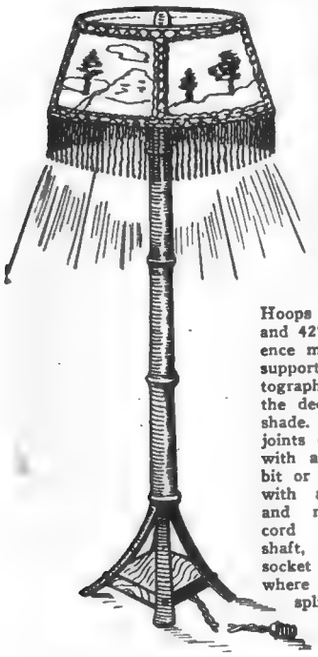
This diagram shows a front and back view of the contact shoe for the model railroad. Insulation surrounds the shoe clamp.

The photograph below shows the bottom view of the locomotive of the toy railway. Note how the wheels are coupled together by means of chains.



HOW TO MAKE IT

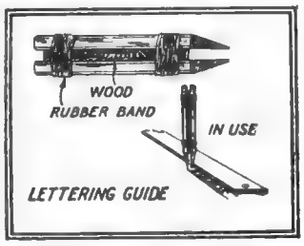
BAMBOO LAMP STAND



A piece of bamboo, four photographs, some braid and fringing may be made into an artistic stand lamp as shown in the accompanying drawing. Both ends of the bamboo are split into four sections and spread apart as supports. Hoops of wire 38" and 42" in circumference may be used to support the four photographs comprising the decoration of the shade. Bore out the joints of the bamboo with a long shanked bit or burn them out with a red-hot rod and run the light cord through the shaft, fastening a socket at the point where the bamboo is split at the top.—L.M. Curtis.

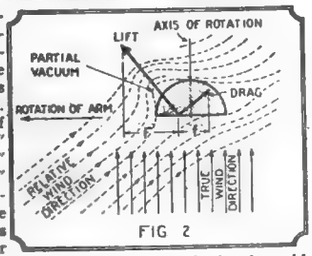
A LETTERING GUIDE

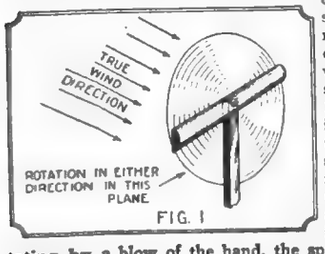
When a large number of guide lines must be made for lettering a drawing, two pencils (each flattened on one side) may be arranged as shown here. The thickness of the block regulates the spacing.—E. H. Fisel.



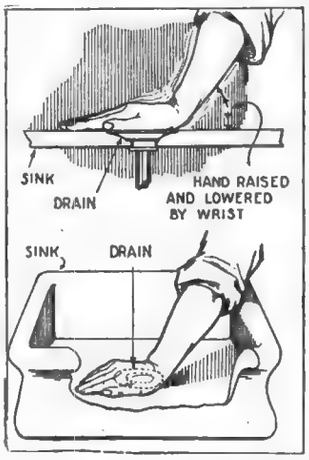
LANCHESTER'S PARADOX

A very interesting experiment, performed with simple apparatus, is shown in Fig. 1. A piece of wood, say 12" long by 1¼" wide and ¼" thick, is shaped so that the cross-section is circular throughout the whole length. Exactly in the middle of the flat side a ⅛" diameter hole is bored for the pivot screw by which the model is mounted on a long, thin stick (after the manner of a child's paper windmill) as shown in Fig. 1. If the stick is now held so that the flat side of the model faces into the wind and the model is started rotating by a blow of the hand, the speed of rotation increases steadily until only a transparent disc is visible. Fig. 2 shows the action of the wind which causes rotation.—W. S. Brown.



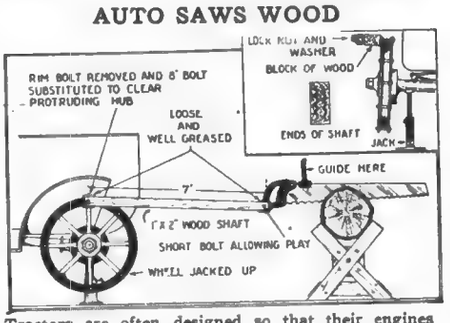


OPENING SINK PIPE



The next time your sink becomes filled with sediment and the drain seems to be stopped up, just place your hand over the opening (forming a sort of a cup with the palm) and move it up and down by raising and lowering your wrist. This will create a small suction which will free the sediment in the drain so that water may wash it out.—W. Walters.

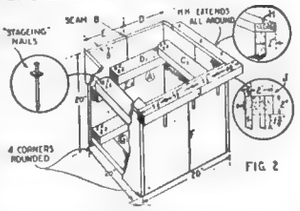
AUTO SAWS WOOD

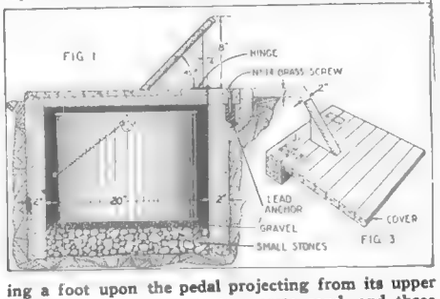


Tractors are often designed so that their engines may be used as stationary power plants to aid the farmer in his daily tasks, but it is more rare to find a method of adapting the automobile to these uses without damage to it and without excessive apparatus. A large hand saw, coupled as shown here to the rear wheel, may be run by the car in low gear.—Harry W. Beckwith.

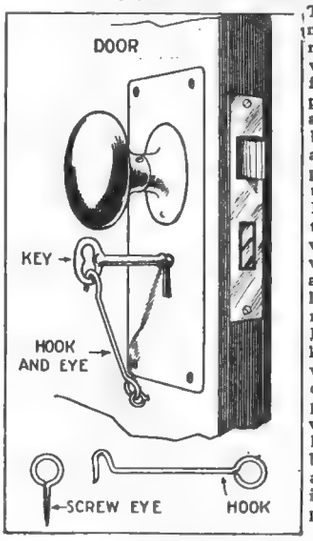
GARBAGE PAIL WELL

A concrete well with a blind drain bottom in which the family garbage pail can be kept, may be made at a very small cost. The form for moulding the well is made of light lumber into which the concrete for the walls is poured. The dimensions given at the right will be found about right for the average pail, but they may be easily altered as may be found necessary. Note the method in which the hinged top is fastened, so that it may be opened by placing a foot upon the pedal projecting from its upper side. One part cement, two parts sand, and three parts gravel by volume, make a very good concrete mixture for this use.—Walter Whitley.





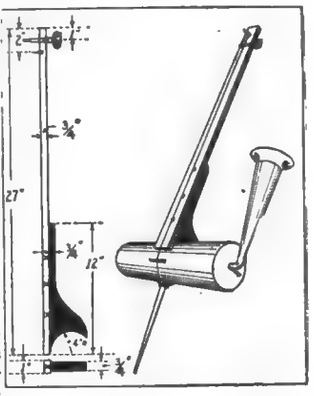
DOOR KEY GUARD



There are many devices made to prevent a door key from being poked out by a lock picker, but they are all rather complicated and unsatisfactory. Inspection of this drawing will reveal a very simple and exceedingly effective method of holding the key in place without recourse to expensive hardware. The hook should be bent back a little to keep it from slipping off and to tighten its grip.—Wilson G. Walters.

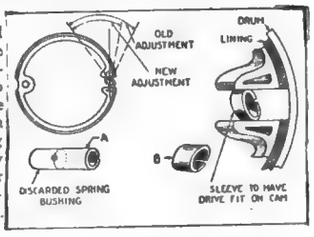
MAKING A CHINESE FIDDLE

A one string fiddle may not seem to be a very ambitious musical instrument, but its mellowness of tone and peculiar resonance will reward the maker for the time spent in constructing it. The body is a length of pasteboard tube, seven or eight inches long by four inches in diameter.—Truman R. Hart.



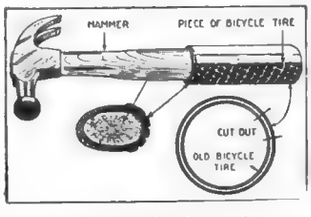
BRAKE TIGHTENING

The method shown here may be employed to tighten the brakes on a Ford making it unnecessary to dissemble or reline them.—C. C. Stuart.



HANDY HAMMER GRIP

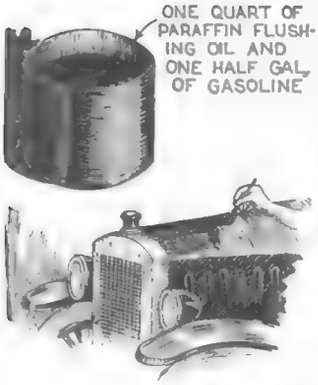
A very neat and strong grip for a hammer, hatchet or bicycle handle bar (in fact any place where a strong grip is needed) can be made from an old [illegible] shown. It may be fastened with cement.—Wilson G. Walters.



WRINKLES
RECIPES & FORMULAS

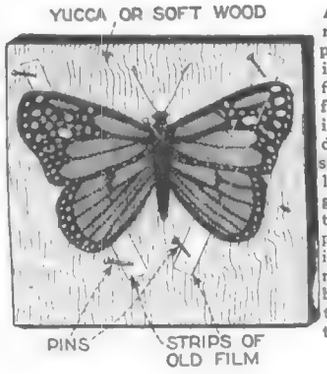
Edited by S. Gernsback

CHEAP AUTO-BODY POLISH



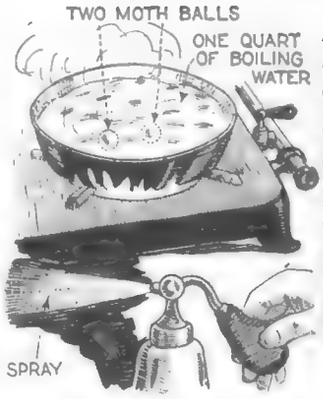
An excellent auto-body polish may be made for about 10 cents a quart or less. Buy a quart of paraffin flushing oil and add to it half a gallon of gasoline. The gasoline acts as a very effective cleaner and the paraffin gives the required lustre.

MOUNTING SPECIMENS



An excellent method of temporarily mounting butterflies or moths for inspection is to hold them down with strips of old celluloid photographic film through which pins have been inserted. The markings may be clearly seen through the transparent film.

A FLY-KILLING SPRAY



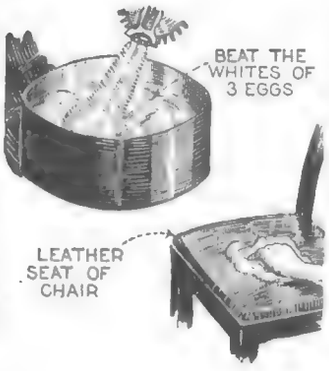
A very good insecticide may be made by dissolving two moth balls in one quart of boiling water. The solution should be sprayed from an atomizer, and will be found as efficient as most of the rather expensive preparations sold commercially.

THE MAGIC STRING

A string which will suspend a ring and other small articles even after burning, can be made by filling the threads of a cord with soap and soaking overnight in a salt water solution. After drying, a ring may be hung up by the string, and will remain suspended by the ash after the string has been ignited and burned.

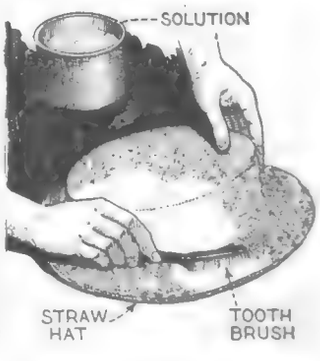
CLEANING LEATHER CHAIRS

Thoroughly beat the whites of three eggs, then with a piece of soft flannel cloth rub the beaten whites into the leather of the chair seat. The leather will soon be clean and will shine as if new. Lamp black may be added if the leather is black.

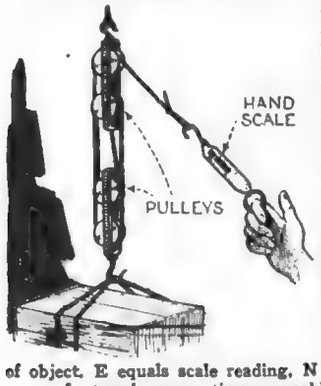


CLEANING STRAW HATS

An excellent straw hat cleaner may be made by mixing four parts of sodium bisulphite, two parts of tartaric acid and two parts of borax. Add water and apply to the straw hat with a toothbrush. When clean, wipe the hat with a moist, warm cloth and set aside to dry.

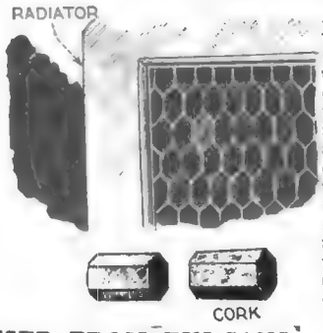


WEIGHING HEAVY OBJECTS



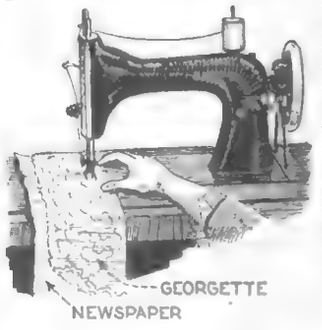
Often heavy objects must be weighed when nothing but a small scale is available. By using pulley blocks and rope, as accessories, the task may be easily done. The pulleys are connected as shown, and the formula R/E—N is applied; R equals weight of object. E equals scale reading, N equals number of strands supporting moveable pulley.

EMERGENCY RADIATOR REPAIR



A leaky radiator cell of a honeycomb type illustrated can be readily repaired by forcing into it a piece of cork cut to fit. It will be found that a very sharp razor is required to cut the cork smoothly without chipping it.

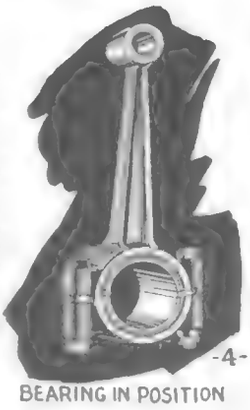
SEWING GAUZY MATERIALS



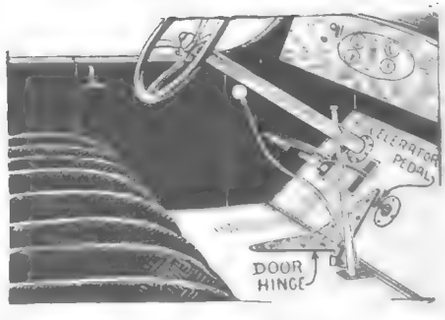
When sewing georgette, chiffon, or any thin material of similar texture on the sewing machine, the seams may be prevented from puckering if a strip of newspaper is placed under the material and the two stitched together.

BEARINGS IMPROVISED FROM TIN CANS

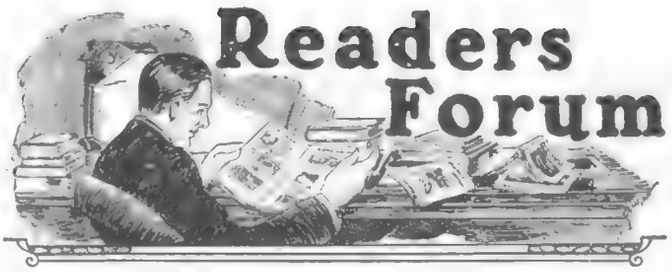
Motor bearings seem to have a habit of burning out at the most inconvenient times. Generally, such an accident leaves the motorist stranded miles from the nearest garage and unable to proceed further. If he knows enough about his motor to be able to remove the connecting rod from the crank-shaft, he will be able to improvise a pretty fair bearing by building one up out of tin cans cut to shape.



ACCELERATOR PEDAL EXTENSION



An extension to the accelerator pedal may be made with a strap-hinge half of which is screwed to the bottom foot-board, the other half resting on the pedal. Pushing on any part of the free half of the hinge with the foot will depress the accelerator pedal.



SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

MORE GENERAL SCIENCE

Editor, SCIENCE AND INVENTION:

I have just purchased and read through the August issue of your publication SCIENCE AND INVENTION. I have been reading this magazine for more than six years; I even read it when it was THE ELECTRICAL EXPERIMENTER.

In looking back over my files of SCIENCE AND INVENTION this evening, I have been comparing the last ten or eleven issues with the wonderful type of magazine you were publishing in 1924 and before. The rotogravure sections and the lack of "How to Make It" was what made this magazine. This "How to Make It" is all right perhaps, but it should constitute a magazine of its own.

The wonderful articles you used to have are now replaced by "How to Make It" for those fellows who have a workshop and it crowds out the scientific articles you used to have.

I encounter much difficulty in expressing my views to you on this matter of the changing of the scope of this magazine, but in a talk with several persons who know science and have been reading your magazine, I find that they agree with me. I understand that you could not possibly edit this magazine to suit everyone, but I do faithfully believe that it would pay you to take this matter up with your readers who make your magazine. I would like nothing better than to see your magazine the leader in science in general.

I hope that I will see an improvement in your magazine, that is, more science and less "How to Make It."

MAURICE WELLER,
Dayton, Ohio.

(The How-To-Make-It Department as it now stands is even smaller than the vote of the majority of our readers wanted it to be. This particular department was the most popular in SCIENCE AND INVENTION *Magazine on the voting contest which we published some time ago.*

Our readers like to build things and showing them how they can build various articles, not only for the home and workshop, but also for the laboratory is to them an education in itself. They want just enough general science so as to keep abreast of all the developments which occur monthly. However, we would like to hear from other readers on the points expressed in your communication, even though we regret that we will be unable to publish all of the letters received.—EDITOR.)

LIFE ON MARS

Editor, SCIENCE AND INVENTION:

In an articles I read not long ago, a prominent astronomer stated that Prof. Lowell's theories, in regard to the possibility of intelligent life on Mars, are no longer given any serious consideration by scientists. He said Mars could not possibly sustain animal life, because of the long, extremely cold winters and the rarity of its atmosphere. He admitted, rather grudgingly, I thought, that vegetation of some sort might grow there during the summer.

I am afraid that this gentleman is guilty of dogmatism which has always been the greatest impediment to the advancement of science. Just why should the fact that Mars has a rare atmosphere and a very severe winter prove Lowell wrong?

Granted, that present conditions on Mars are unfavorable for any great evolutionary development. But Mars wasn't always in this condition. There must have been a time in its history when it had everything essential to the development of life. Intelligent beings may have lived there then, and it is possible that the fittest of them have survived until the present day.

We know from observation on the earth that wherever there is the slightest possibility of life, we are sure to find it always adapted to prevailing conditions. The limits of adaptibility are not known. Mars has reached its present state through a gradual process of change, and there has been plenty of time for Nature to bring about the necessary structural alterations in order that animal life might survive. Even though evolution has been inadequate to this task, is it not possible that the inhabitants foresaw the coming of the cold and scarcity of air, and made provision for it by artificial means? Who knows but what they wear oxygen tanks, and live in underground cities during the winter, utilizing the summer season for growing crops?

Nobody who reads Prof. Lowell's books on Mars with an open mind can fail to be deeply impressed by his startling discoveries, and the sound logic by which he reaches his conclusions. He presents a staggering amount of evidence, the result of years of careful observation, in support of his theory that Mars is inhabited.

CHARLES FORNER,
Baltimore, Md.

(We also believe that it is perfectly possible for Mars to be inhabited. Are there not inhabitants at our Polar regions where little vegetation grows? The Eskimos in the North have been able to provide for life and yet the temperature there falls very much below zero. Prof. Lowell does make the subject very interesting in his book. We are in accord with the running head in our magazine which reads, "Those who refuse to go beyond fact, rarely get as far as fact." Therefore we believe as above that Mars may be inhabited.—EDITOR.)

LIKES SCIENCE AND INVENTION

Editor, SCIENCE AND INVENTION:

I am only fifteen, being a Sophomore in high you my appreciation of SCIENCE AND INVENTION Magazine, the equal of which, I fully believe, cannot be found anywhere.

I am only fifteen, being a Sophomore in high school, and am approaching my sixteenth birthday, the age at which, according to a statement of yours, a boy should know for what he is best fitted. At present I can think of no more useful or interesting a work than that of a scientist, and a scientist I intend to be. SCIENCE AND INVENTION Magazine is largely responsible for this decision.

I realize that this magazine is published fundamentally for persons older than myself and I cannot understand everything in it, but most of it is so simply written, and profusely illustrated, that when I have read all that I can understand, it has much more than repaid me for having bought it.

I do not read much besides what I am compel'ed to read in school, as anyone who knows me well will testify, but I do read SCIENCE AND INVENTION Magazine, and enjoy it to the fullest extent. I would be willing to heartily recommend it to anyone interested in science as the best buy he could possibly make for the price.

I am not a subscriber, but procure a copy of this magazine at some newsstand whenever I feel that I will have time to read it, and with the exception of a few fraudulent or misleading advertisements to be found here and there in each issue, I have no fault whatsoever to find with it.

DAVID D. MURRAY,
Clarendon, Va.

(We are glad to know that you like SCIENCE AND INVENTION *Magazine and we wish you the best of success in your efforts to become a scientist.*

We do take issue with you on the statement found in your last paragraph that there are a few fraudulent or misleading advertisements to be found in each issue of this publication. This magazine tries to check up on all fraudulent advertising long before an effort is even made on the part of the advertisers to place copy in any issue. If complaints are received concerning any advertiser, we attempt to rectify the matter immediately, and if the complaint was not due to an oversight on the part of the manufacturer and is a legitimate complaint, that manufacturer is refused the right to advertise in this publication. It is against the law to publish a misleading advertisement and we try to protect our readers as well as the bona fide advertisers wherever possible. Should you have any legitimate complaint, we will be glad to have you take it up with our Advertising Department.—EDITOR.)

AMAZING STORIES IN OUR JANUARY ISSUE

THE RED DUST, by Murray Leinster. You have, of course, read "The Mad Planet." "The Red Dust" is a sequel to this all-absorbing and now famous story. Here we see further and more exciting adventures of the hero Burl.

THE MAN WHO COULD VANISH, by A. Hyatt Verrill. The author of "Beyond the Pole" and "Through the Crater's Rim" has written what is, to our mind, a real masterpiece. Mr. Verrill treats invisibility in a quaint manner and the science by which he does this seems correct in all respects. You will read and reread this story.

THE MAN WITH THE STRANGE HEAD, by Dr. Miles J. Breuer. When a medical doctor turns author, you may be sure that he will write a story that we can all enjoy. "The Man with the Strange Head" is certainly as amazing and strange a story as you would wish to have told.

THE FIRST MEN IN THE MOON, by H. G. Wells. Our adventurers are now on the moon, or, rather, inside of it, and are fast getting acquainted with the superhuman insect race which he pictures as reigning on our satellite. The second installment is packed full of weird and exciting incidents that you can never forget.

THE SECOND DELUGE, by Garrett P. Serviss Cosmo Versál was right. The deluge covered almost all the highest mountains of the Himalayas. In this installment we are told of many exciting adventures in submerged cities.

PRICE 25c PER COPY
AT ALL NEWSSTANDS

SUN SPOTS AND RADIO

Editor, SCIENCE AND INVENTION:

Wish to commend you on the excellent editorial on "Sun Spots and Radio" in the August number. A few more of the same kind will have a tendency to stop a lot of this idle speculation about the danger of another glacial period or a change of climate, etc., etc.

I would suggest that when you write again on the subject, that you would call attention to the fact that what is now transpiring in the sun is practically the same experience which the earth passed through in comparatively recent times.

The only tenable hypothesis that explains the cause of these phenomena is, that they are the result of the force of gravitation.

The spots are simply vortexes in the sun's atmosphere which at present seem to increase and decrease in regular cycles. But there is no certainty that they will continue to do so.

In the seventeenth century for instance, it is a well authenticated fact that scarcely any spots appeared for one period of twenty years and for another of eight years.

So it seems safe to assume that there is no certainty about it, any more than there is to the eruptions of Mt. Vesuvius. When the spots are numerous we can feel assured that they will continue so indefinitedly, but when there are none visible, there is no guarantee that the condition will continue for even a single day, for they are the result of eruptions, no doubt.

The fact that there has been a regular cycle noticeable for several hundred years proves little, for the reason that in the sun's history the difference between one year and one thousand years is practically negligible.

To refer to another thing, it is claimed that the movement of the solar spots represents the rate of rotation of the sun's disc, but it undoubtedly does not; any more than the low pressure areas that are noticed in the earth's atmosphere are an indication of the rate of rotation of the earth.

In the case of the earth they move faster eastward than the surface of the earth directly underneath, for the reason that the earth's atmosphere is heated from without and much warmer at the equator than elsewhere; while in the case of the sun, the atmosphere is heated from within and equally over the whole surface.

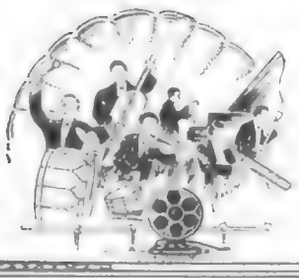
Theoretically, the sun spots should move slower than the sun's surface. By Kepler's third law it can be shown that the sun spots do not move rapidly enough even if the sun's surface extended out as far as limits of the gaseous envelope.

The spots as they appear to us are a considerable distance from the sun's surface and simply lag behind. How else can it be explained that the spots on one hemisphere move more rapidly than they do on the other? It might be said that Kepler's third law does not apply in this case, but if it does not, then there is no certainty of anything, for it is mathematically demonstrated.

It is not probable that Kepler realized it, but when he discovered this law he had found almost absolute proof of the certainty of the truth of the Nebular Hypothesis for the reason that the law is simply a statement in slightly different form of the ratio that exists between spheres. For instance, the hypothesis is that the sun's surface extended to the mean distance of the present orbit of the planet Neptune. So, the rate of rotation of the sun's disc at that time was nearly what the period of Neptune's rotation is at the present time. Now the law says that the ratio existing between the different planets is governed by the cube of the mean distance from the sun in connection with the square of the periods of rotation. This is only another way of stating that the ratio is represented by the cube of the radius of a sphere whose diameter is that of the orbit of the planet which we wish to apply the law to. In mathematics the diameter is generally used instead of the radius, but it amounts to the same thing. So, Neptune's period of revolution governs or rather points to the period of revolution of all the other planets and of the sun itself. Not only that, but it indicates a fact that prevails throughout the Universe. It simply exists, the same as any other mathematical fact, and that is all there is to it.

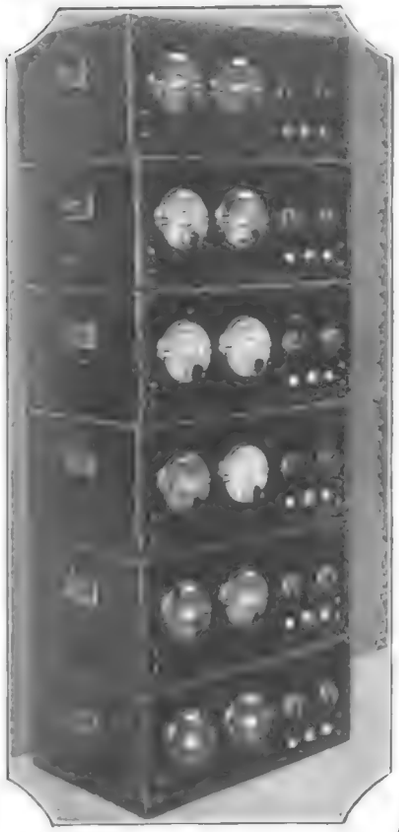
My idea is, if you can give the people something that there is certainty in, like the August editorial, it will do a lot of good. Anybody knows, if he has made any investigation at all, that the average heat of the sun will vary but little for a few million years or so; that there is no danger

(*Continued on page* 855)



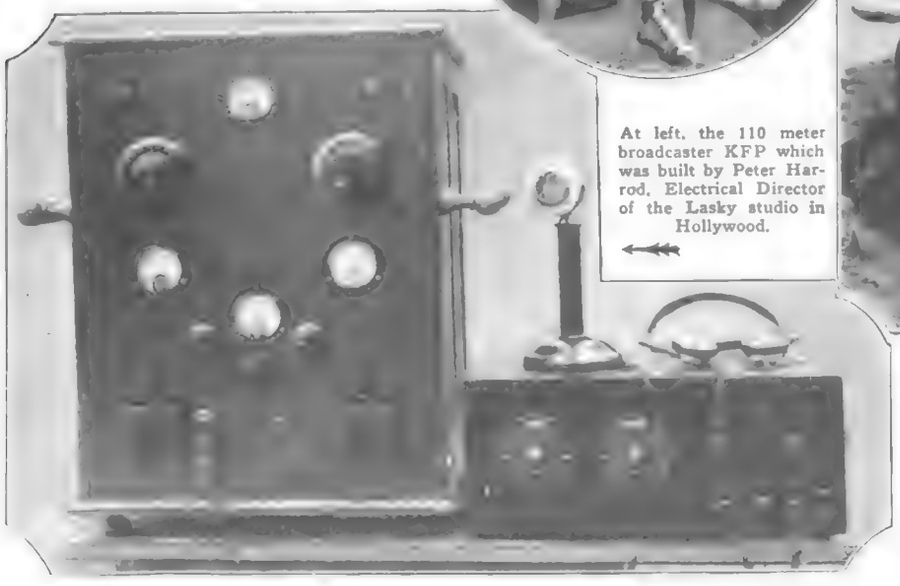
RADIO

"Old Ironsides" and Radio



No, this is not a super-super-whatsitdyne! These are the receiving sets used by director James Cruze to distribute his orders in the filming of the Paramount feature picture "Old Ironsides." At right, one of the camera men awaits his orders. All the big scenes of this production were directed by radio.

Cruze directed the maneuvers by talking directly with ships in the bay below. Each ship was equipped with a receiving set, and continuous contact was sustained between the director and his assistants. The broadcasting outfit is seen directly in front of Mr. Cruze. Mr. Cruze declares that whatever success the picture may make will be due in large part to radio.



At left, the 110 meter broadcaster KFP which was built by Peter Harrod, Electrical Director of the Lasky studio in Hollywood.

When he found that he was going to have trouble keeping in touch with his assistants and the hundreds of extras, James Cruze, the famous Paramount director, decided to adopt radio as a means of intercommunication. He was able, by using a small broadcasting set, to control the action to the most minute detail, at the same time doing away with any delay resulting from misinterpretation or non-delivery of orders. Cecil De Mille used field telephones extensively in the production of "The Ten Commandments", but this is the first time that radio has been used in this way.

How to Make a Simple Drum Dial

By HERBERT E. HAYDEN

Fig. 1. First, go out and buy a set of common embroidery hoops. Discard the outside hoop and remove the felt strip from the inside hoop. Clean the fluff entirely out and a neat channel will be formed.

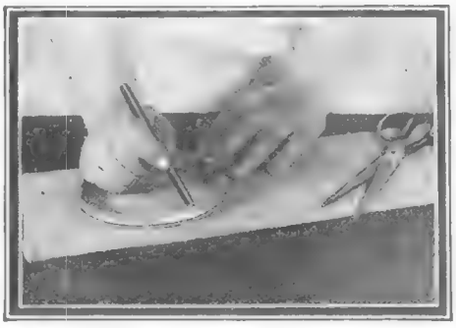


Fig. 2. A piece of heavy cardboard, called "illustration board," is next purchased from an art store. Place the ring upon the illustration board and draw a circle on the inside as shown above.

Fig. 3. The circle marked out in Fig. 2 should be cut out neatly with a pair of shears. A sharp razor blade makes a good tool to even up the edges of the disc so that it will fit closely into the hoop.

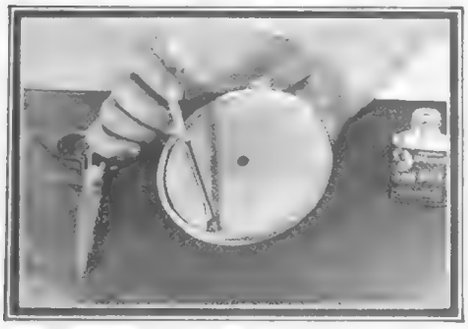


Fig. 4. Next locate the center of the cardboard disc and drill a ⅛-inch hole exactly at this point. The disc should then be carefully centered and glued into place. Celluloid dissolved in acetone makes a very good glue.

Fig. 5. A standard bushing made to fit over a ¼-inch shaft of a variable condenser is obtained from a hardware store. The bushing is then drilled and tapped as shown above for a 2/56 machine screw.

Fig. 6. The bushing is then fitted through the center hole of the disc and the retaining nut is fastened down. Care must be taken that the insertion of the bushing does not throw the disc out of line.

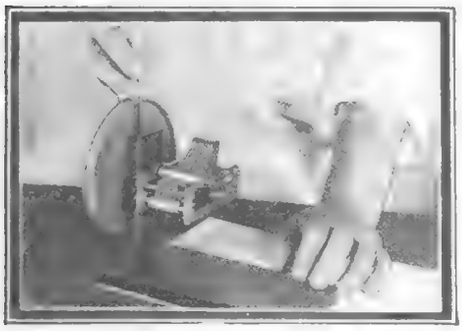


Fig. 7. The variable condenser is now mounted on a small piece of bakelite which is in turn clamped to a baseboard as shown in the photograph. Slide the dial on the shaft and tighten the 2/56 screw.

Fig. 8. A thin strip of paper just wide enough to completely fill the channel in the hoop is marked off in degrees or numbers and pasted into the channel.

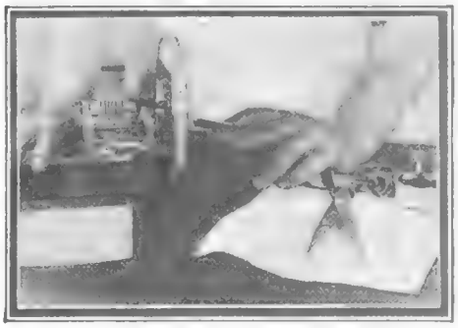


Fig. 9. A cardboard template is fitted and cut to measure in order that the dial may be properly centered in the panel, and to act as a guide for cutting bakelite.

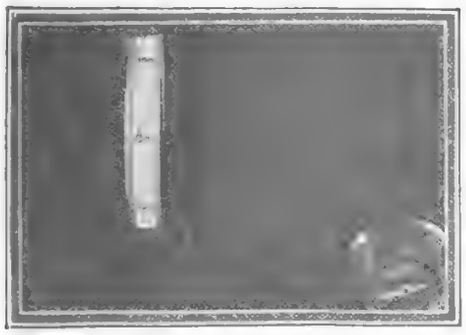
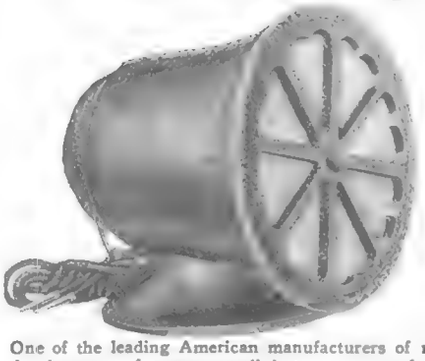
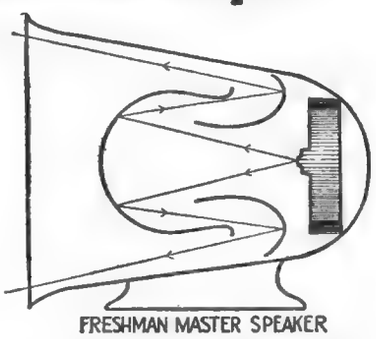


Fig. 10. The bakelite is cut following the design of the template shown in Fig. 9. This is best done by drilling holes at the corners and using a fretsaw to make the cuts. A file may be used for final smoothing.

Novel Loud Speaker Developed

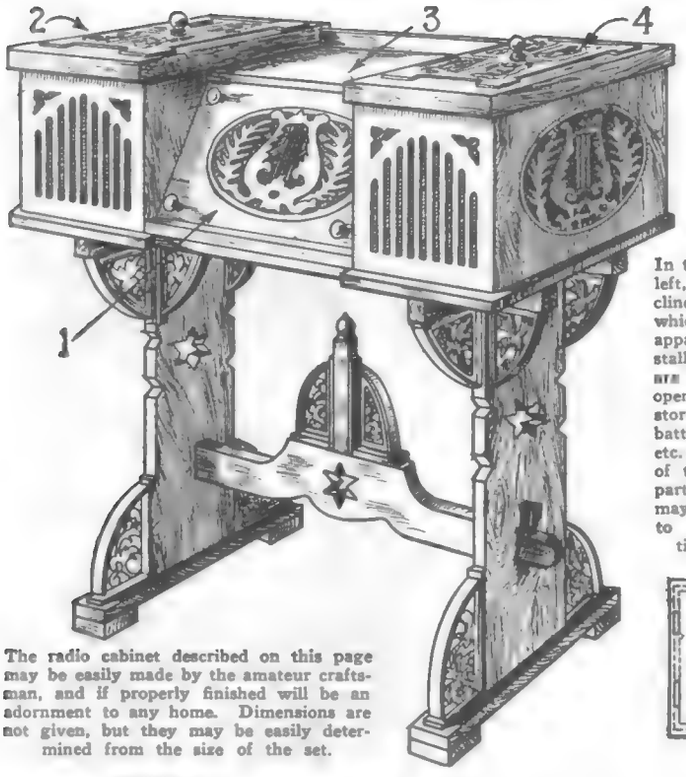




FRESHMAN MASTER SPEAKER

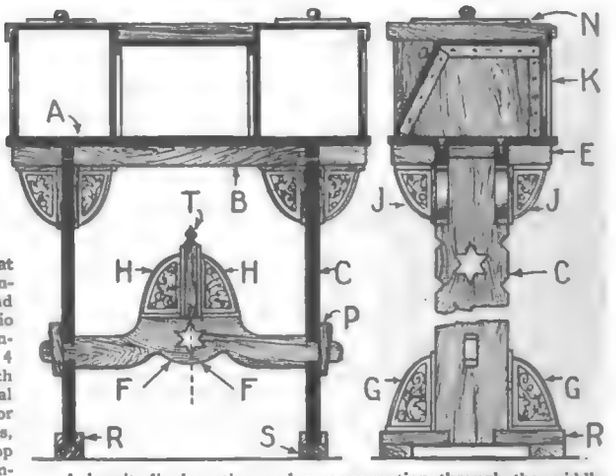
One of the leading American manufacturers of radio sets and accessories recently announced the development of a new small but very powerful loud-speaker, an illustration of which is given above. The principle of tone reflection is employed in the design of this instrument and it is surprising that such a large volume and clear reproduction can be obtained from a talker only 7½ inches long and 6 inches high—Courtesy Charles Freshman, Inc.

Home-Made Radio Cabinet De Luxe

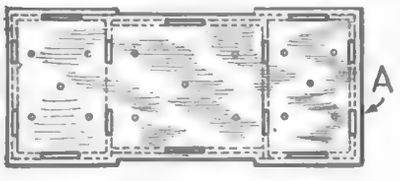


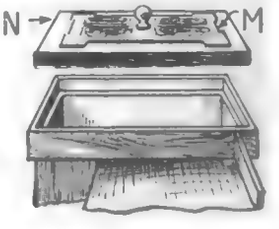
The radio cabinet described on this page may be easily made by the amateur craftsman, and if properly finished will be an adornment to any home. Dimensions are not given, but they may be easily determined from the size of the set.

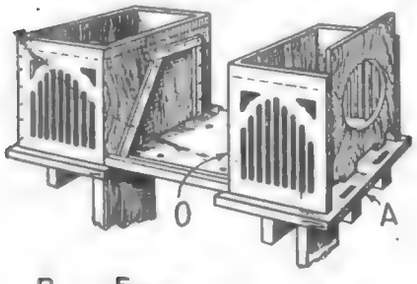
In the full view at left, 1 is an inclined lid behind which the radio apparatus is installed; 2 and 4 are lids which open to reveal storage space for batteries, phones, etc.; 3 is the top of the radio compartment which may be removed to permit inspection et cetera.

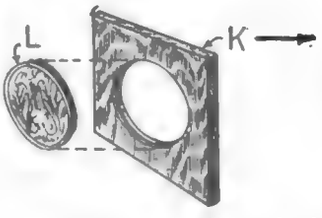


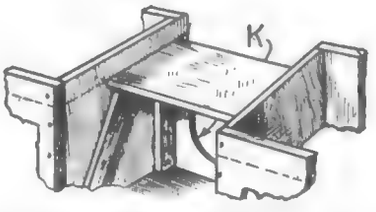
A longitudinal section and a cross-section through the middle of the de luxe cabinet are shown in the drawing above. In all the drawings on this page, corresponding parts are denoted by the same letter to aid in interpretation.

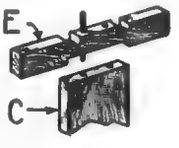




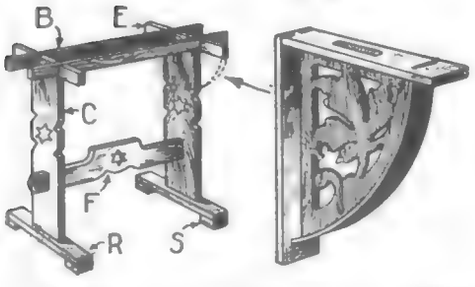


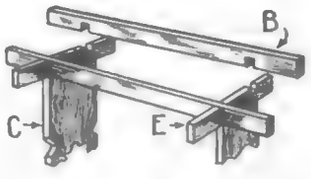


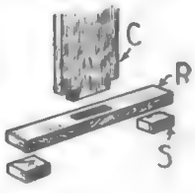




Above at left, the usual cabinet-maker's devices are employed in assembling the cabinet. The end panels are made so that they may be slid out of their frames to allow batteries or chargers to be fitted into place the more easily. The fretwork decorations are made in the form of inserts which may be glued into place in the panels or held by friction. The platform is pegged to the base.

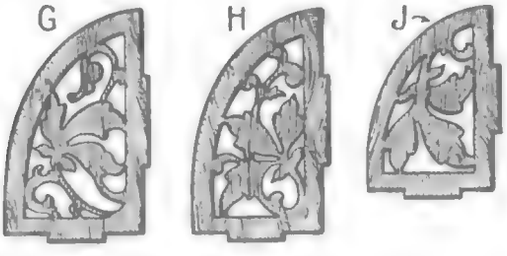




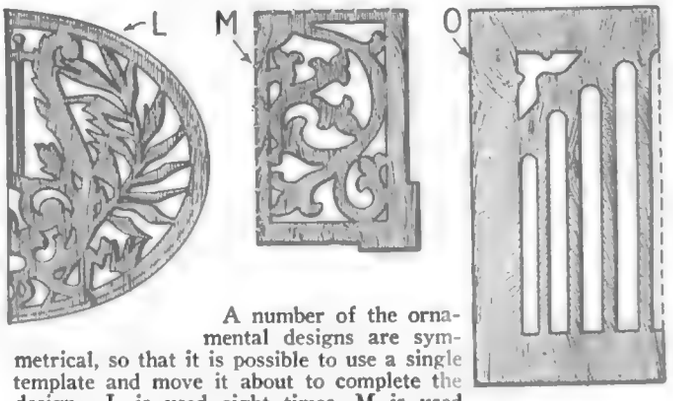


Details of the supporting legs and their decorative touches are illustrated here. The selection of the type of lumber to be used is entirely up to the individual taste of the maker, some wood being suggested which may be stained and finished without too much labor.

The detailed drawings set forth on this page are all "close-ups" of the integral portions of the de luxe cabinet. This apparatus can be made a graceful and decorative part of the furnishings of any home, and must necessarily be of great use and much convenience.



One of the best ways to save unnecessary labor in the laying-out of the decorative devices illustrated here, is to draw the decoration to full scale on a piece of smooth cardboard. The design is then cut out of the cardboard and is used as a template for cutting the wood to the required shape and size. Three-ply hardwood panels make good material with which to work.



A number of the ornamental designs are symmetrical, so that it is possible to use a single template and move it about to complete the design. L is used eight times, M is used four times, and O may also be used four times, to complete the decorative plan of the cabinet.

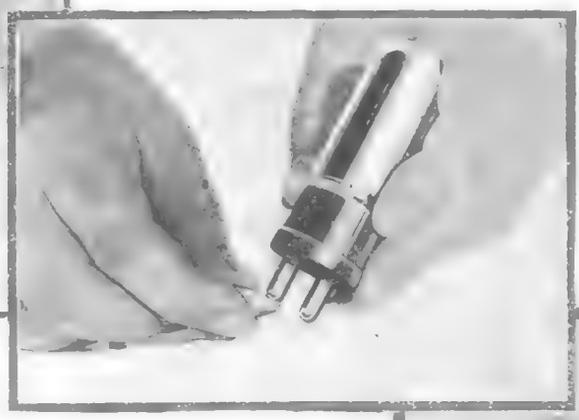
—Courtesy Illustreret Familie-Journal.

Tube Sockets from Rubber Heels

A Very Good and Inexpensive Socket If the Directions Here Are Followed.

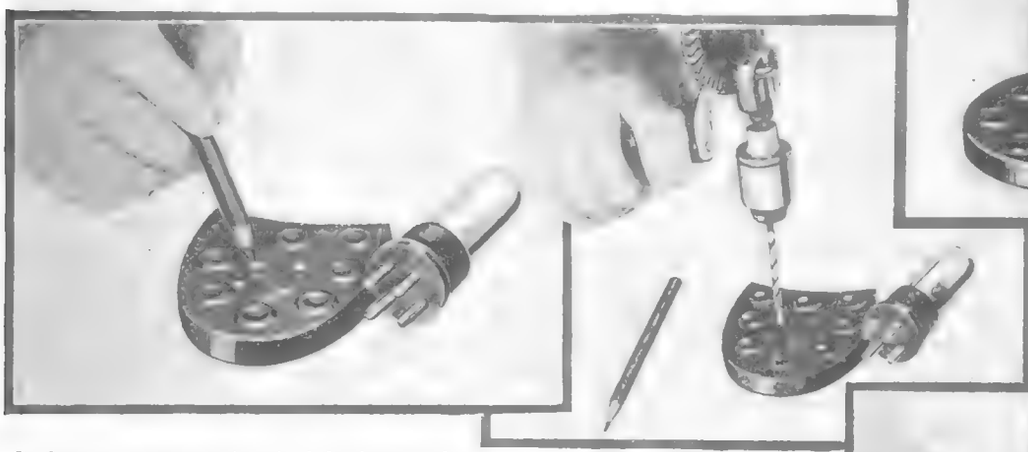
By HERBERT HAYDEN

The photo above is not intended to limit the experimenter to the field of used rubber heels, but is included in a helpful spirit, in case the unfortunate reader does not know exactly where to locate that unusual article. Rubber heels may be obtained at any shoe repair shop for the sum of one dime each.



White chalk should be smeared on the prongs of the vacuum tube as illustrated in the photograph above.

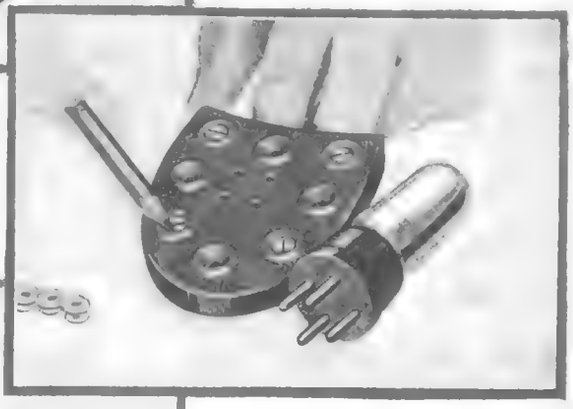
Below, the vacuum tube is firmly pressed down on the desired portion of the rubber heel, so that the chalk on the prongs will leave marks which will serve to locate the holes to be drilled.

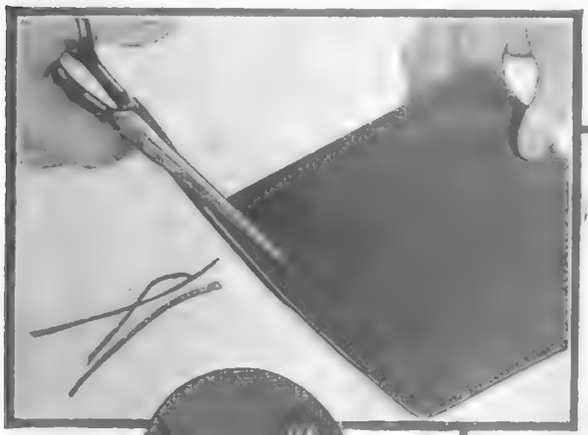


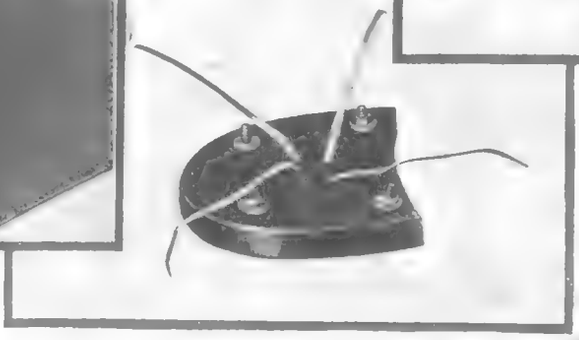
It is very necessary that the holes be properly spaced to prevent any unusual tension being placed on the prongs of the vacuum tube.

The heel should be tacked down to the table or board used as a work-bench, and the holes carefully drilled with a high-speed bit. A red hot nail may be used if a drill is not available.

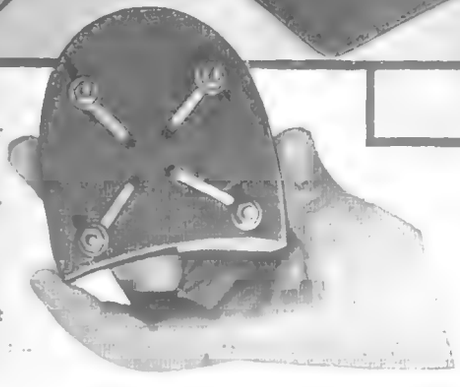
Below, mounting screws for the binding-posts are inserted through the nail holes, as shown here. The indentations normally found on the bottom of the heel furnish ready-made countersunk holes.





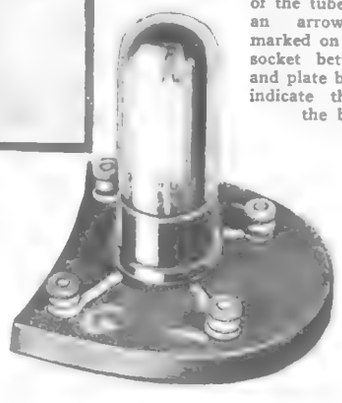


Narrow strips of soft-copper are cut to form contact springs for the tube prongs. They are held in place by soldering at either end to binding posts.



Above, the soft copper strips are carried through the holes just bored. The strips should be wide enough to afford sufficient contact area to be sure of low resistance between the contacts and prongs. At left, the strips are soldered, both above and below the rubber "base" to lugs attached to the binding posts.

It should be remembered in constructing this socket that the filament prongs of the U.X. type vacuum tubes require larger holes than the grid and plate prongs. To prevent incorrect insertion of the tube in the socket, an arrow should be marked on the top of the socket between the grid and plate binding posts to indicate the position of the base pin.



Building a Good "B" Eliminator

By JOSEPH CALCATERRA

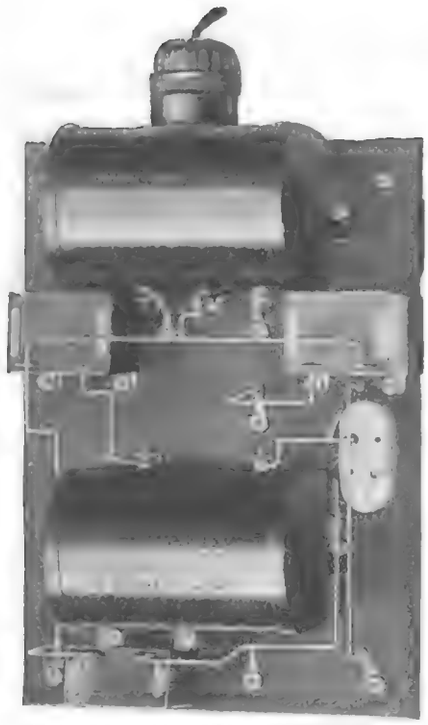


Fig. 1. A bottom view of the "B" battery eliminator shows the neat arrangement and simple wiring used. The unit rests on the choke and transformer cases.

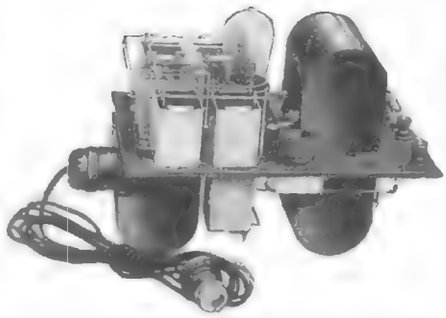


Fig. 2. A side-view of the unit shows it ready for operation. It will be seen that the cases of the choke coil and transformer make excellent feet for the unit.
Photos courtesy All-American Radio Corp.

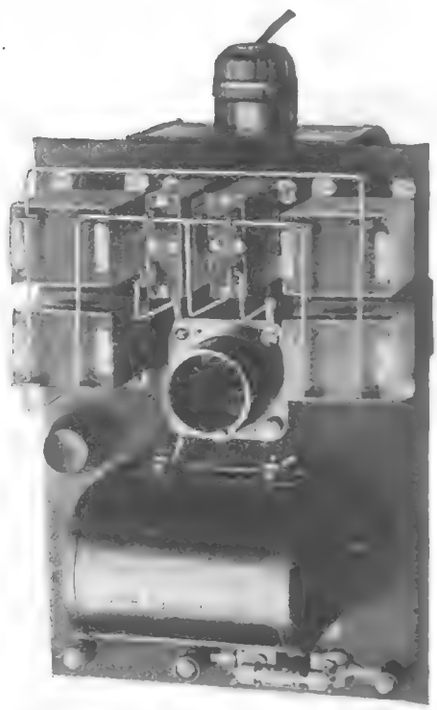


Fig. 3. The filter condensers, tube socket, choke coil and voltage regulators are mounted on top of the base as may be seen in the photograph above.

THE connection scheme of the tube in the eliminator unit is shown in Fig. 4. As you will notice a tapped secondary transformer, number 14 is used. The output terminals of the device are numbers 1 and 4. Number 2 is a tap for smaller output voltages which are regulated by resistances numbers 3 and 6.

One side of the output circuit which is connected with the number 1 terminal is connected through choke coils numbered 5 and 16 with the plate or large-area cathode electrode "P" of tube number 9. The other side of the output circuit from terminal number 4 is connected with the tap of the secondary winding of the transformer. One of the small-area anode electrodes of the tube is connected with one end of the transformer secondary while the other small-area anode electrode is connected with the other end of the transformer secondary. The tapped connection method of connecting the transformer is such that a current induced in the secondary winding will make one end of the winding positive while the other end is negative and vice versa when the current reverses.

The current in the output circuit through the rectifying action of the Raytheon tube will always be in one direction but instead of using only one-half of the cycle as is the case in most "B"-power supply units, it uses both sides of the wave thus producing a smoother flow of current and more economical operation.

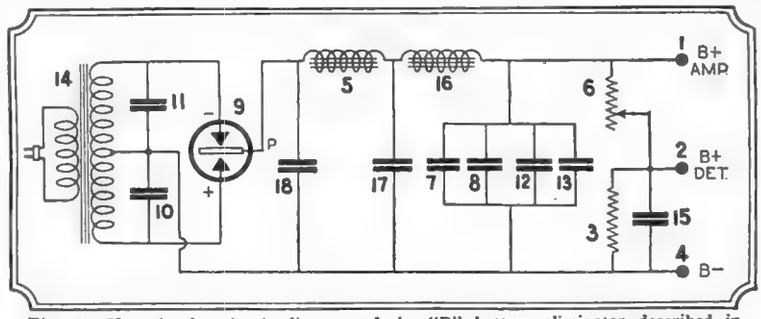


Fig. 4. Here is the circuit diagram of the "B" battery eliminator described in this article. A Raytheon tube is used for rectification, and a very efficient filter system is incorporated.

The rectification obtained with this type of device is about as perfect as it has been possible to obtain with any practical rectifier.

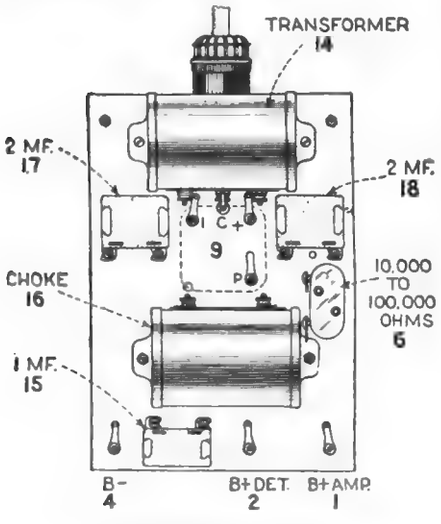
The estimated life of the Raytheon tube is ten years, at least ten times as much as the ordinary filament rectifier tube.

Most of the "B" battery eliminators designed for use with the Raytheon tubes have been more or less clumsy affairs, assembled on a flat board so that they take up a lot of table space. While such arrangements are all right for laboratory purposes, they occupy too much space for use in the home or with sets having compartments designed for dry "B" batteries.

I have designed the plate current supply unit which I am describing in this article so as to make it more compact; suitable for use in the home with the average set which does not have a "B" battery compartment. In this case the unit can be fitted into a small cabinet of appropriate size. The overall dimensions of the unit are 10 inches long, 7 inches wide and 8¼ inches high. A set of two large-sized 45-volt "B" batteries take up a space 9 inches long, 8¼ inches wide and 7½ inches high. The weight of the unit is 14 pounds as against 27½ lbs., for two "B" batteries.

The unit is very easy to adjust and operate. There are only three terminals to be connected with the set, thus eliminating the necessity of connecting two 45-volt "B" batteries together. There is only one adustment, that of the variable resistance 6 for controlling the detector voltage. When once adjusted it can be left alone without further attention as

(*Continued on page 847*)



...e drawing of the same view ...graph above, will give a clear ...ive positions of the apparatus.

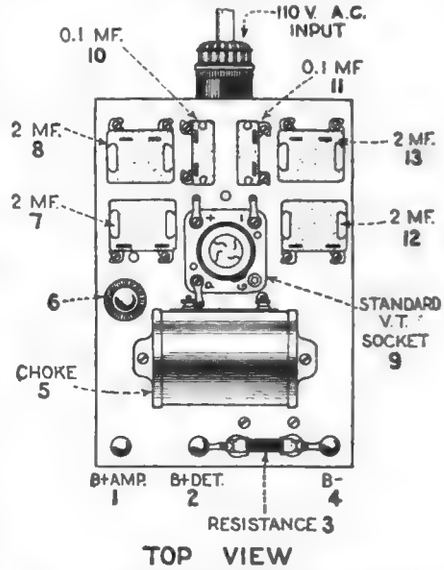


Fig. 6. The designations correspond to those in the article in these columns and in the diagram at center of page.

RADIO ORACLE

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

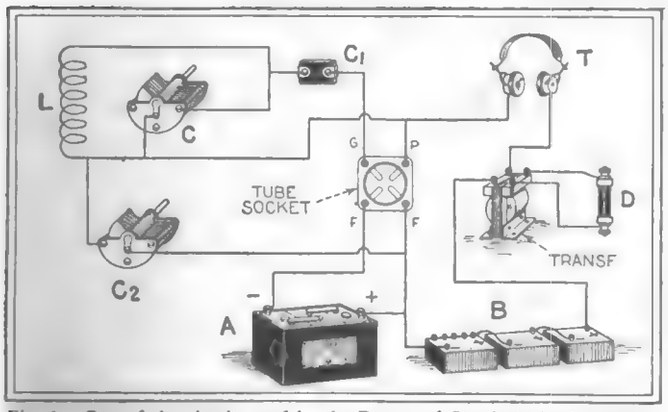


Fig. 1. One of the circuits used by the Bureau of Standards in the measurement of currents too small to actuate the ordinary measuring apparatus.

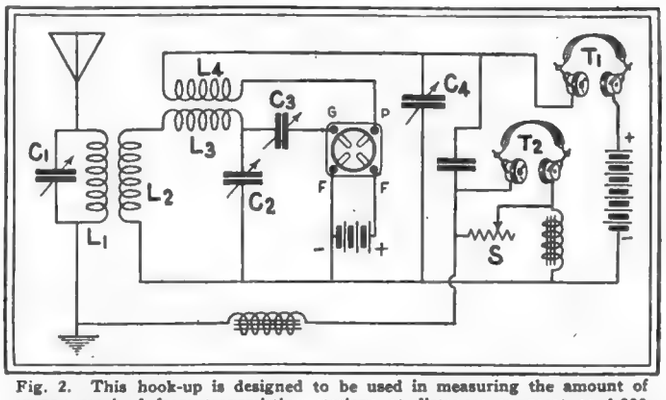


Fig. 2. This hook-up is designed to be used in measuring the amount of energy received from transmitting stations at distances as great as 4,000 miles. The station is tuned in by using phones T1, while T2 is used for measurements.

MEASURING SMALL CURRENTS WITH THE VACUUM TUBE

(519) Q. 1. Mrs. R. E. Garriett, Pittsburgh, Pa., inquires if there is any known method of measuring extremely small currents with accuracy.

A. 1. Although it is not a matter of general knowledge, laboratory tests have shown that the vacuum tube is a valuable instrument of precision for use in measuring currents almost infinitesimally small. Fig. 1 on this page shows one of the circuits developed by the Bureau of Standards for this purpose. The coil, L, is inductively coupled to the circuit which carries the current to be measured, while a sensitive galvanometer is connected in series with detector D. A local current is generated by the oscillation of the vacuum tube circuit, the frequency of which is regulated by the tuning condenser C. A note is produced in the telephone, T, by the beats between the impressed and the local currents. The condenser C4 must be adjusted for maximum deflection of the galvanometer.

L. W. Austin, in the *Journal of the Washington Academy of Science* states his conclusion that the deflections are proportional to the square of the high frequency current flowing in the circuit being measured. This also means that the current in the telephone is proportional to the first power of the high frequency current. This law holds only for the oscillating condition. When the audion is not oscillating, the deflections are approximately proportional to the fourth power of the high frequency current.

This constitutes a method of remarkable sensitiveness for measuring small high frequency currents. Austin found that for signals of minimum audibility on the simple audion, the oscillating audion gave audibilities 300 to 1000 times as great; that is, it would measure currents hundreds of times smaller. For convenience in measuring radio currents received from distant stations, the shunted telephone is used in connection with the oscillating vacuum tube. The arrangement shown in Fig. 2 is that used by Austin in this type of work. The shunt, S, is used on the telephone T2. The audibility is approximately proportional to the current in the aritenna. The sensitivity is always measured at the time of use in comparison with a silicon detector and galvanometer, which combination is in turn calibrated by comparison with a thermo element. This arrangement has been used to make quantitative measurements on undamped waves from radio stations 4000 miles away, the least high-frequency current detectable in the receiving antenna being .000000004 ampere.

FRESHMAN MASTERPIECE RECEIVER

(520) Q. 1. J. F. Durhan, Waterbury, Conn., asks that we publish the circuit diagram of the popular Neutrodyne receiver manufactured by the Chas. Freshman Co., Inc.

A. 1. The diagram below shows the circuit connections of the latest Masterpiece receiver. The "trap" inserted into the plate returns of the 2 stages of radio frequency should be particularly noted. The effect of the small condenser and air core inductance used here are designed to reduce the possibility of undesired oscillation, and, in connection with the 210-ohm resistance, to aid in regulating the B-battery voltage to these tubes. We note in your question that you refer to this as a neutrodyne receiver, but as a matter of fact it is a tuned radio frequency receiver, in which oscillation is controlled by absorption lossing, and not by neutralization.

THE CATHODOPHONE

(521) Q. 1. Mr. Thomas C. Martin, Los Angeles, Calif., writes that he has read in news dispatches of the use of a microphone called the "Cathodophone" and inquires as to the details of this instrument.

A. 1. It is a "glow" microphone, but is not the same as the glow microphones using an arc. The invention is based upon the findings of Wehnelt, that the surface of incandescent wires coated with refractory oxide (such as barium oxide, calcium oxide, or strontium oxide) gives off free negative electrons in rarefied gas. This property has been discovered to hold in air at normal pressures also.

The high speed of the electron is missing, in the last case however, as the free electrons collide with oxygen and nitrogen molecules, thus producing ions. The glowing oxide body being made the cathode (hence the name of the transmitter), the ions will drift slowly to the anode and thus become carriers for the electric current.

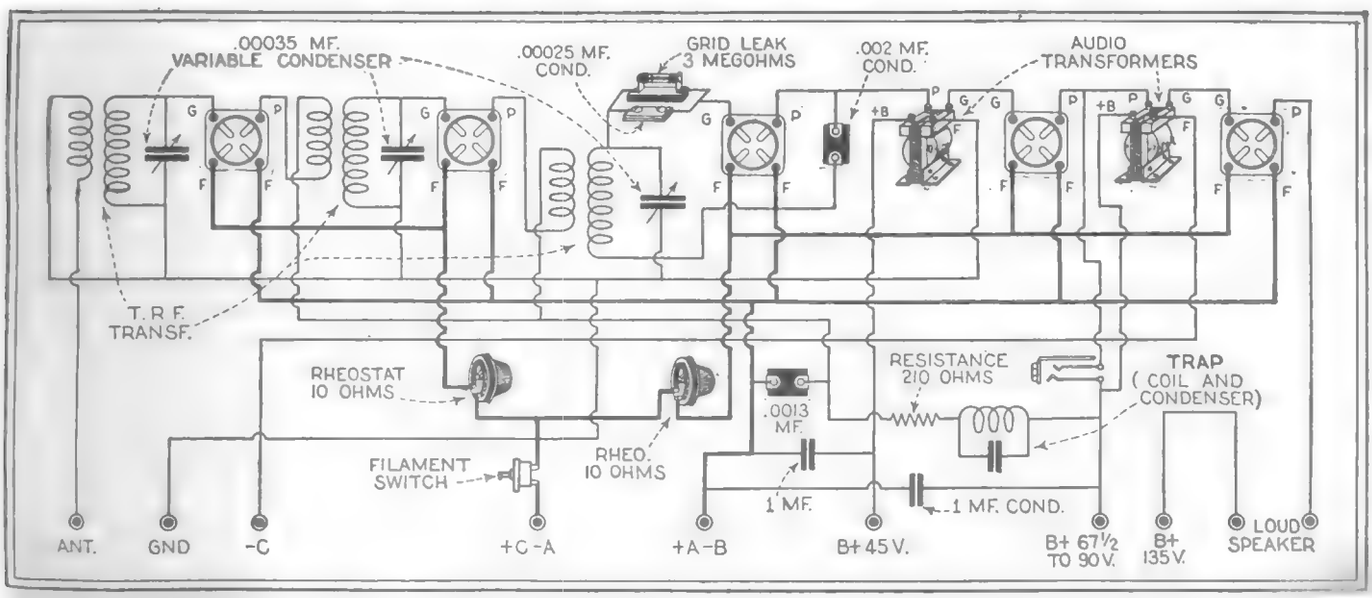
This "ion current" or "emission current" is subject to various pressure modifications in much the same way (but to a higher degree) as the atmosphere. When a sort of "box" of refractory material coated with an oxide is made incandescent by a current a bluish glow is set up between it and a perforated diaphragm slightly separated from it by an air gap. The diaphragm is also the small end of a funnel which catches sound waves—the funnel being slotted to avoid vibratory distortion. Thus sound oscillations will be transmitted to the glowing portion of the air gap, causing variations in the "emission current." These are registered in the circuit of which this air gap is a part, via a resistance, and are carried through tube amplifiers.

INTERMEDIATE FREQUENCY TRANSFORMERS

(522) Q. 1. Mr. H. R. Lash, Sault Ste. Marie, Ont., writes us concerning intermediate frequency transformers in his superheterodyne.

A. 1. If you find that you hear stations at more than two points on the oscillator dial, it would seem to indicate that the various intermediate frequency transformers are not tuned alike. You should be able to get some radio expert in your city to check these up for you.

In the first place, you require an accurately calibrated wavemeter and the wavelength to which the transformer is tuned is to be adjusted by varying the capacity of the condenser shunted across it. Without using any wave meter at all, the amateur can experiment on the set as it is by trying different capacities, preferably using a small adjustable condenser shunted across the secondaries of the transformers, the condensers being adjusted alternately while listening to a distant station until the maximum strength of signals is obtained.



The circuit above is that of one of the more popular tuned radio frequency receivers at present on the market. It is not a neutrodyne circuit

Scientific Humor

HITTING THE MARK

A keen-eyed mountaineer, where bitter feuds were common, led his over-grown son into the schoolhouse.

"This boy's arter learnin." What's yer bill o' fare?"

"Well, Sir, I teach mathematics, algebra, geometry, trigonometry."

"That'll do," interrupted the old man. "Load him up on triggernometry. He's the only poor shot in the family."—*Halsted Condage.*

AND WIFIE GOES UP IN SMOKE

The easiest way for a woman to keep the home fires burning today is to say something about an old flame every now and then!—*Henry A. Courtney.*

WATCH OUT

"That new boy I hired is a crystal gazer" remarked the grocer to his wife.

"Is that so?" she asked.

"Yes, he's continually looking at his watch."—*Merle A. Wilson.*

OR IN SERIES FOR ARC TEMPERATURES

The physics Class had just completed the study of electricity and a general review was started. The measurement of heat was under discussion.

PROF: "Can a mercury thermometer be used to measure heat at the North Pole?"

STUDENT: "Certainly."

PROF: "You are wrong. It would freeze at the temperature found there. An alcohol thermometer must be used."

STUDENT: "But why not connect several mercury thermometers in parallel"—*Willard Desing.*

A CORKER

"What is the best specimen of quartz we have," asked the professor of his geology class.

"Old Crow," replied the absent-minded student, "but they charge you ten dollars for one,"—*Ernest R. Lowe.*

HE AUTO

HE: "Would you like to go driving Sunday?"

SHE: "Yes."

HE: "Here is a nail, go get yourself a hammer."—*M. Goldberg, Rep.* 29256.

First Prize $3.00

H_2O

PROF.: "What is the formula for water?"

FROSH: "H I J K L M N O."

PROF.: "What! Where did you get that idea?"

FROSH: "Why yesterday you said it was H to O."—*R. C. Anderson.*

WHY NOT MAKE IT SPINELESS?

MOSES: "Look at dat chestnut burr."

RASTUS: "Niggah yoh ig-rance am shocking. Dat ain no chestnut burr, dat am a porcupine egg."—*Robert Lambe.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

WATER, WATER

PHYSICS PROF: "I want some one in this room to explain why we have water analogies in the study of electricity."

BRIGHT STUDE: "The reason for having water analogies is so that the subject will not be so dry."—*Carl Kossen.*

HOT STUFF

He struk her, but she uttered no sound. He struk her agin butt no wurd eskapt her lipz. Once moore he hitter on the hed brav thing that she wuz, she did not even whimpurr. Then enraged beyond awl reegons at herr unconcern of his akshuns, the brute uttered a lo oth and began raining blos on her pretee little hedd, even skratching her in his maddness. Even thru this she remained silent. Butt finally, not being able to stand it any longer, shee heved a reluktant sputer and berst into flame. For you see she wuz only a match.—*Leonard Keiser, Jr., Rep. No. 27612.*

MODERN PHARMACY

THIRSTY: "You know, I'd like to be one of these here drug clerks."

HUNGRY: "I'd like to know why?"

THIRSTY: "'Cause the other day I went into the drug-store to get a medical prescription filled."

HUNGRY: "Yes."

THIRSTY: "Well when I handed across a bottle and asked for five cents worth of alcohol the clerk took it and blew one little breath into it and handed it back to me."—*Harry F. Weber.*

D.C.C.—DON'T CHANGE CIRCUITS

RADIO NUT: "Give me a pound of No. 14 Direct Current Copper wire."

STORE CLERK: "Direct Current Copper wire?"

RADIO NUT: "Yes. The book said to use a pound of No. 14 D.C.C. wire."

TUNED IN WITH HIM!

SHIEK: "I'd like permission to marry your daughter sir?"

THE SIR (crabbily): "What's your business?"

SHEIK (airily): "I'm a radio announcer."

THE SIR: "All right. You're accepted. You're the first one to say good night and mean it!"—*Henry A. Courtney.*

MACK OR GARDEN?

DUMB: "I'm troubled with a rumbling in my stomach."

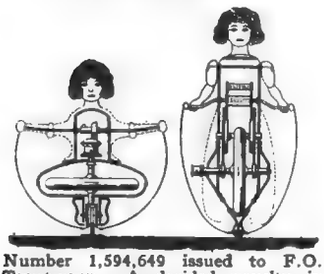
BELL: "Must be that truck you ate for dinner."—*Clifton Ask.*

MEET SIMON, OUR AMATEUR SCIENTIST!

POOR OSWALD! THAT WATER LOOKS VERY UNSANITARY! -- ALL FULL OF GERMS AND MICROBES AND THINGS!
THIS IS THE KIND OF WATER HE NEEDS! FIRST I'LL BOIL IT THOROUGHLY TO KILL ALL THE HARMFUL BACTERIA! ---
--- AND THEN IT'S COOLED DOWN TO JUST THE RIGHT TEMPERATURE -- POOR OSWALD WILL WELCOME THE CHANGE!
AND NEXT DAY
SCIENCE LESSON NO. 2
ALL ANIMALS NEED OXYGEN. THE FISH GETS ITS OXYGEN FROM THE SMALL QUANTITY OF AIR WHICH IS ALWAYS FOUND DISSOLVED IN WATER. ALTHOUGH BOILING WILL KILL THE GERMS IN WATER IT WILL ALSO DRIVE OUT THE DISSOLVED AIR, AND SO MAKE THE WATER UNFIT FOR THE FISH TO LIVE IN.
W LAMKIN

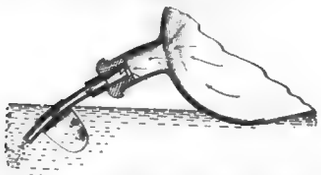
LATEST PATENTS

SKIPPING TOY

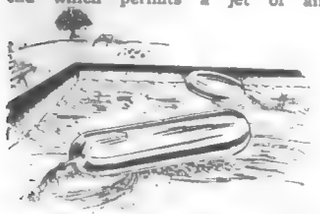


Number 1,594,649 issued to F.O. Trautmann. A decided novelty in amusements which also holds considerable of scientific interest is represented in this design for a mechanical toy. Two varieties of the toy are shown above. At the left, a doll is caused, by means of a gyroscope and other apparatus, to progress along a wire or rope with intermittent leaps or skips, between which jumps a skipping rope is causeed to pass between the feet of the doll and the wire. A variation, designed to move along on a flat surface with an intermittent skipping motion, is illustrated at the right.

BALLOON BOAT



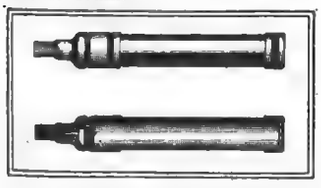
No. 1,596,852 issued to R.C. Foster. Here is something in the way of a novelty, evidently inexpensive to manufacture, which should have a strong appeal for the younger members of the family. A balloon of more or less cylindrical shape is filled with air by means of a pump or with the aid of the lungs. A slow-leak valve is provided at one end which permits a jet of air



to escape. The balloon is placed in water and the jet of air causes it to be propelled rapidly by virtue of the reaction principle involved. A small lead rudder is provided to aid in controlling the direction of motion. The forward progression continues as long as any compressed air remains in the balloon.

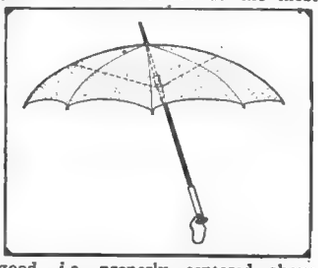
FOUNTAIN BRUSH

No. 1,589,949 issued to Chas. A. Dowd. An invention which provides a method of feeding a liquid without loss to the bristles of any sort of brush.



SELF-CENTERING UMBRELLA

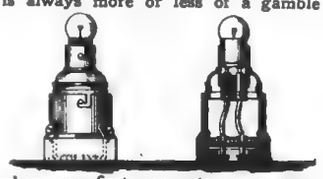
No. 1,594,154 issued to Robt. M. Craig. Umbrellas, although decidedly in the class of necessities, sometimes are the cause of much annoyance. This fault is caused by the fact that they are the most easily lost of earthly belongings, and that they seem never to succeed in protecting the user from rainfall with any degree of thoroughness. The design of the article must be blamed for this, as it is practically impossible with the ordinary umbrella to place it where it will do the most



good, i.e. properly centered above the head. Now, along comes someone with a real, practical idea; that is, to arrange the handle at an angle so that the umbrella may be held in the hand at the side of the "wearer", and at the same time shield his noble brow from the wrath of J. Pluvius.

RADIO TEST LAMP

No. 1,596,524 issued to J. Ginsburg. Exceedingly rare are those radio fans who have not blown out at least one set of vacuum tubes by putting the "B" battery where the "A" battery should have been connected. It is always more or less of a gamble



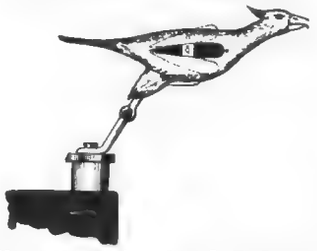
when one first connects up a new-built radio set, none too sure of the accuracy of the connections. Here is a little device, consisting of a 6-volt flashlight bulb mounted on a standard UX type tube base, which can be depended upon to reduce the cost of such disasters by affording a simple filament circuit test.

PAPER BOX OPENER

No. 1,594,963 issued to J. James. Cardboard boxes, although inexpensive and efficient as packing cases, are sometimes very trying on the nerves when it is found necessary to open a number of them in succession. Usually a screw driver or a sharp knife are employed, sometimes with disastrous consequences to the

contents of the box. A modified can opener has been developed to fill the need, which consists essentially of a circular blade of steel, the depth of whose cut is limited by a guard. The device is operated by pulling it across the surface of the container to be opened, the blade cleanly cutting the cardboard.

RADIATOR ORNAMENT



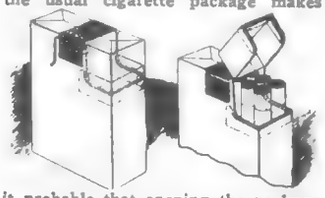
No. 1,593,085 issued to J. F. Lang. A very clever device to be used as a radiator ornament for automobiles is illustrated by the above drawing. A bird, made of metal and provided with moveable wings, is arranged so that the body is moveable relative to the legs and the wings relative to the body. The wings, normally outstretched in the same approximately horizontal plane, are caused to operate the mechanism which imparts a graceful fluttering motion similar to that of a bird in flying. Air is the moving force.

TOY BANK

No. 1,594,847 issued to Harwood Otto. The Goose That Laid the Golden Egg is typified in the ingenious design for a child's bank illustrated here. When a coin is deposited in the mouth of the goose, it rolls down a chute, tripping a latch which in turn permits a piece of candy simulating an egg to be ejected from the body of the goose. This device would be of interest particularly to savings banks.

CIGARETTE PACKAGE

No. 1,589,603 issued to A. W. Lee. It is well known that the design of the usual cigarette package makes



it probable that opening the package will result in injury or destruction to a portion of its contents. This package has a tear-string imbedded in the wall of the package which, when pulled, causes a corner of the container to be neatly torn off at the same time retaining the flap as a means of closing the package when desired. This invention suggests that the principle might be utilized in a number of other fields of industry, where similar requirements are to be met. The idea is particularly adaptable to metal containers having a close-fitting cap whose junction with the body of the can is covered with a paper strip. Removing the paper is usually quite troublesome, but should not be so if the practice of placing a fine pull-string under the paper at the junction were more universally followed.

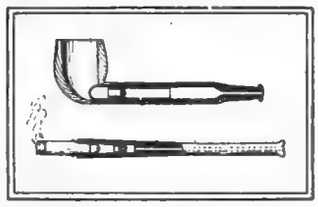
SWIMMER'S SAFETY BELT

No. 1,596,573 issued to J. Beaulieu and E. Conners. This invention would probably be more properly described as a safety belt for bathers, rather than swimmers. At any rate, we fail to see how a swimmer would be able to make much progress with these various bands of buoyant material suspended about his anatomy. The patent paper states that the life-saving feature consists of containers (presumably) a part of the bathing-suit placed around the waist, breast and neck, which contains either air or some other material which would tend to

increase the buoyancy of the bather. On second thought, the idea may not be so bad after all for the use of women and children or those who have not mastered the aquatic art. It is well known that very little assistance is needed to float the human body in fresh water, and this help could be easily gained from a belt of cork or kapok fiber, built into the bathing costume.

JUICELESS PIPE

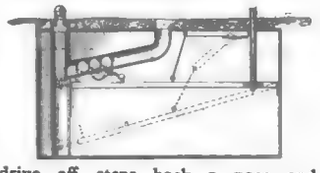
No. 1,594,606 issued to G. L. Clivio. Another of the many methods, more or less practical, proposed



for extracting nicotine and other oils from tobacco smoke, with a view toward reducing the toxicity of the same. It consists essentially of a series of deposition chambers in which the oils carried by the smoke are caused to precipitate and condense, preventing their reaching the lungs of the smoker.

GOLF TESTING MACHINE

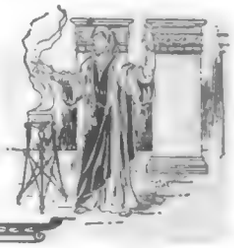
No. 1,598,971 issued to Edw. Kenyon. This is an idea to do away with much of the fuss and labor involved in teeing-up in the ever-popular game of golf. The mechanism operates very simply. The players step up to the teeing ground and deposit their balls, in the order in which they will be driven off, in a metal tube whose opening is flush with the surface. The first man to



drive off steps back a pace and pushes a lever with his foot, which releases his golf ball from the chute to the top of a cylinder.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information. —EDITOR.

THE ORACLE



The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RECTIFIER SOLUTIONS

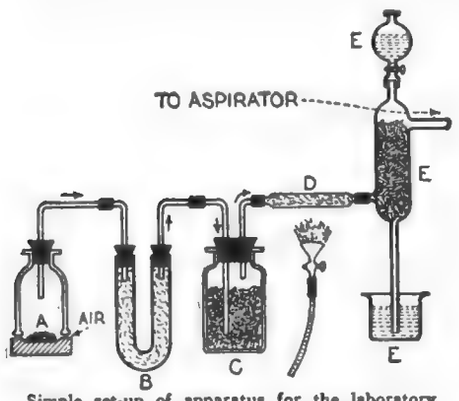
(2149) Q. 1. C. L. Adelman, New Brunswick, N. J., asks: The names of the constituents that form the solution of an electrolytic rectifier of the aluminum type.

A. 1. There are several solutions which may be used in electrolytic rectifiers. Probably the most favored one is a solution of ammonium phosphate. The solution should be not quite saturated. If you dissolve the salt in cold water and then allow it to stand a few hours, the clear liquid may be used. Another good solution is borax in water, the solution to be made in the same way as described above.

PREPARATION OF SULPHURIC ACID

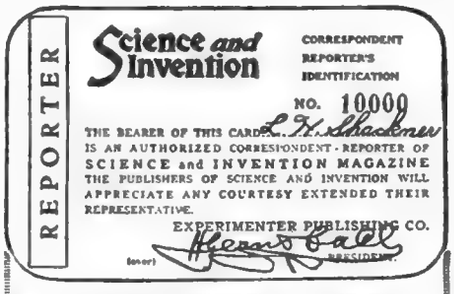
(2150) Jack Smith, Denver, Colorado, wants to know how sulphuric acid is produced commercially.

A. 1. Sulphuric acid is produced by two distinct methods on the largest commercial scale. One is called the *chamber process*. Sulphur or pyrites are burned producing sulphurous acid gas, sulphur dioxide, SO_2. The gas contains considerable dust which settles out before it is treated. The gas then goes through a tower in which it is mixed with oxides of nitrogen produced from the decomposition of nitric acid, produced from sodium nitrate, and the mixture is admitted into a large chamber lined with lead and is mixed with steam. Here sulphuric acid is deposited, the oxidation of the sulphurous oxide being accomplished by the nitrogen oxides. The nitric acid is produced by the action of sulphuric acid on sodium nitrate. This process is being gradually supplanted by the *contact process*. Sulphur dioxide produced as in the other process is mixed with air and purified by settling to get rid of dust which purification is absolutely essential. It is then passed through and over a catalyst consisting of finely divided platinum which has been deposited on asbestos. The catalytic action causes the sulphurous oxide to combine with the oxygen of the air which is mixed with it producing sulphur trioxide SO_3. The gas is absorbed in sulphuric acid highly concentrated to start with, and if ordinary sulphuric acid is required, water is constantly added in sufficient amount to produce an even run of sulphuric acid, by combining with the sulphur trioxide. The sulphur trioxide could be absorbed by water, but the reaction would be extremely violent, and this violence is avoided by using a less energetic solvent.



Simple set-up of apparatus for the laboratory catalysis of sulphur trioxide and production of sulphuric acid.

The *laboratory preparation* of sulphur trioxide (SO_3) and sulphuric acid (H_2SO_4) by the contact method, is represented in the accompanying diagram. Sulphur (A) burns in the air which is drawn into the apparatus by an aspirator. The sulphur dioxide together with the excess of air passes into the U-tube (B), which is filled with some loose material to rid the gases of sulphur dust. The gases are dried in the bottle (C), which contains glass beads wet with concentrated sulphuric acid. The union of the sulphur dioxide with the oxygen of the excess air is brought about through catalysis by the gently heated platinized asbestos (D). The sulphur trioxide resulting from the action is absorbed by a mixture of sulphuric acid and water or by concentrated sulphuric acid if fuming acid is required in the apparatus (E).



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Address Field Editor, SCIENCE AND INVENTION.

Submitted manuscripts cannot be returned unless accompanied by postage.

MAGIC BOTTLES

(2151) Q. 1. Mr. Caesar Lunk, Tabriz, Persia, asks how the famous "magic bottle" illusion is produced.

A. 1. The mystery of the "wonderful bottle," from which can be poured in succession port wine, sherry, claret, water, champagne, or ink, at the will of the operator, is easily explained. The materials consist of an ordinary dark-colored pint wine bottle, seven wine glasses of different patterns, and the chemicals described below:

Solution A: A mixture of tincture of ferric chloride, drachms vi; hydrochloric acid, drachms ii.

Solution B: Saturated solution of ammonium sulphocyanide, drachm i.

Solution C: Strong solution of ferric chloride, drachm i.

Solution D: A weak solution of ammonium sulphocyanide.

Solution E: Concentrated solution of lead acetate.

Solution F: Solution of ammonium sulphide, drachm i; or pyrogallic acid, drachm i.

Package G: Pulverized potassium bicarbonate, drachm iss.

Having poured two teaspoonfuls of solution A into the wine bottle, treat the wine glasses with the different solutions, noting and remembering into which glasses the different solutions are placed. Into No. 1 wine glass pour one or two drops of solution B; into No. 2 glass pour one or two drops of solution C; into No. 3 one or two drops of solution D; leave No. 4 glass empty; into No. 5 glass pour a few drops of solution E; into No. 6 glass place a few grains of package G; into No. 7 glass pour a little of solution F.

Request some one to bring you some cold drinking water, and to guarantee that it is pure show that your wine bottle is (practically) empty. Fill it up from the carafe, and having asked the audience whether you shall produce wine or water, milk or ink, etc., you may obtain any of these by pouring a little of the water from the bottle into the prepared glass. Thus No. 1 glass gives a port-wine color; No. 2 gives a sherry color; No. 3 gives a claret color; No. 4 is left empty to prove that the solution in the bottle is colorless; No. 5 produces milk; No. 6 effervescing champagne; No. 7 ink.

RELATIVE SPEEDS

(2152) Q. 1. E. Cornella, Mare Island, Cal., asks for the solution of an impractical question.

A. 1. In answer to your question as to whether a man standing on the back platform of a moving train and firing a gun at the engineer in the front, would hit him, we can assure you that if the engineer stood there long enough he certainly would get killed. Likewise, if the engineer fired at the man on the rear platform, the same result would hold. If the man on the rear platform fired a gun whose bullet had a velocity of 60 miles per hour, backwards from the rear of the train the same as that of the train, the bullet would drop vertically to the ground. A bullet fired from a pistol on a moving train will act, as far as objects on the train are concerned, exactly as if the train were standing still.

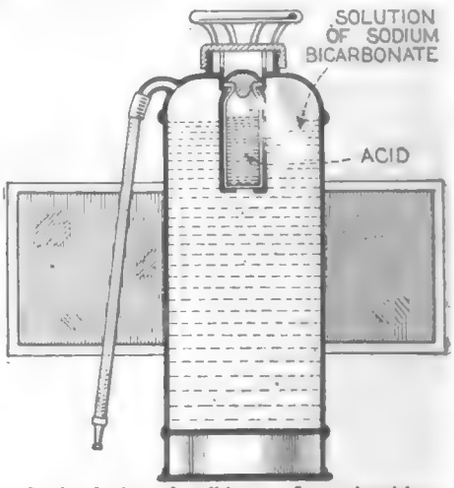
FIRE EXTINGUISHERS

(2153) Q. 1. Fred Ralston, Boston, Mass., asks what types of fire extinguishers are considered efficient by us.

A. 1. One type of fire extinguisher (see accompanying illustration) contains a device for generating carbon dioxide rapidly, as by mixing sulphuric acid with a solution of sodium bicarbonate when the apparatus is inverted. The pressure of the gas forces on the fire a stream of water that contains dissolved and effervescing carbon dioxide and solution of sodium sulphate. In chemical engines the pressure of carbon dioxide is often used to throw a stream of water. Carbon tetrachloride is also extensively used in certain types of fire extinguishers, such as the "Pyrene." When a stream of the liquid is directed against a burning substance, the heat causes it to evaporate rapidly, forming a heavy gas that displaces the air in contact with the combustible material.

There has recently been perfected an extremely ingenious and efficient method for extinguishing oil fires and other fires that have not gained great headway. The fundamental basis of this foam system of fire extinguishing is the use of solutions that, when mingled together, will create a large volume of carbon dioxide gas confined in bubbles of persistent foam, easily applied and readily adhering to any burning surface. The substance forming the foam is termed *foamite*. The carbon dioxide is generated by the reaction between solutions of aluminum sulphate and sodium bicarbonate.

$$Al_2(SO_4)_3 + 6\ NaHCO_3 = 3Na_2SO_4 + 2\ Al(OH)_3 + 6\ CO_2$$



Sectional view of well-known fire extinguisher which produces gas pressure to force out liquid and gas stream.

Foamite is a substance obtained by the second extraction of licorice root. It is mixed with the sodium bicarbonate solution. Foamite plays no part in the chemical reaction, but the aluminum hydroxide and the foamite on coming together form a viscous fluid having a very low surface tension, and the carbon dioxide blows it into a foam that is tough and durable. The solutions are mixed as they are played on the burning surface, where the mixture spreads out in a thick blanket of carbon dioxide foam, resembling thick whipped cream in appearance and consistency. Heat converts the aluminum hydroxide in the foam into aluminum oxide. There is practically no transference of heat through the foam, and the foam does not soak in and cause damage as water does, nor does it injure the material to which it is applied. Nothing thus far developed will equal foamite for putting out an oil fire, and it has decided advantages for use in cases of fire in buildings before the fire has gained much headway

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light,** rendering it **perfectly visible** in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match board, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. **Bottle containing sufficient to coat several small articles, Price 25c. Larger sizes 50c and $1 postpaid. Johnson Smith & Co., Dept. 367 Racine, Wis.**

The "Little Giant" Typewriter

A First Class Writing Machine For $1.50

A perfect little typewriter for $1.50. There are thousands of persons who would like to use a typewriter but whose needs and business do not warrant the expense attached to the purchase and use of a fifty or seventy-five dollar machine. To such persons we confidently recommend our Little Giant. It is strongly made, but simple in construction, so that anyone can quickly learn to operate it, and write as rapidly as they would with pen and ink. The letters of the alphabet most frequently used are so grouped as to enable one to write rapidly, the numerals 1 to 10, and the punctuation marks being together. With this machine you can send your best girl typewritten love letters, address envelopes, make out bills, and do almost any kind of work not requiring a large, expensive machine. With each typewriter we send a tube of ink and full printed instructions for using the machine. **Price complete $1.50 by mail postpaid to any address in the world.**

Every Boy His Own Toy Maker

Greatest boys' book written. Tells how to make a Pinhole Camera, a Canoe, model Railroad, a Telephone, Boomerang, Telegraph Instrument, Box Kite, Talking Machine, Microscope, Electric Motor, Electric Door Bell, Water Wheel, Paddle Raft, a pair of Skis, a Dog Sled, Bird House, Rabbit Yard, etc. 64 pages, 150 illustrations. **PRICE, 10c postpaid; 3 for 25c.**

GOLD TEETH

You know how fashionable it is to have gold crowns—if you can afford it. These gold-finished shells fasten over your real teeth and look like very wealthy fillings. Can be slipped on and off in an instant. Get some and surprise your friends. **PRICE 5 Cents Each, 3 for 15c, or 50c for 1 doz. postpaid.**

JOHNSON SMITH & CO., Dept. 367 Racine, Wis.

REAL PISTOL — Miniature Watch Charm Pistol

Shoots Blank Cartridges

Exact reproduction of a real pistol; actually fires Real BLANK CARTRIDGES of miniature size. Illustration is actual size. 1¼ inches long, with ring at end for attaching to watch chain. Loads like a regular pistol. Pull the trigger and it goes off with a loud bang. Pistol is break-open type; illustration shows position for loading. Made entirely of high grade steel, nickel plated, octagon barrel, handsomely engraved handles, complete in box with cleaning rod. **PRICE $1.75.** Also furnished with **pearl handles, $2.50. BLANK CARTRIDGES, 50c** per box of 25

BOYS! BOYS! BOYS!

THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of fun fooling the teacher, policeman or friends.

THE VENTRILO

a little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Anyone can use it.

Never Fails. A 16-page Course on ventriloquism, and the Ventrilo, ALL FOR 10c postpaid.

MIDGET BIBLE
GREAT CURIOSITY

Smallest Bible in the world. Size of a postage stamp. **200 Pages.** Said to bring good luck to the owner. A genuine work of art. Must be seen to be appreciated. Make good money selling them to friends, church acquaintances, etc. PRICE **15c** each, **3** for **40c**, **12** for **$1.35**, **100** for **$7.50.** Also obtainable in Leather Binding, with gold edges. **Price 50c each, 3 for $1.25, $4.50 per doz.**

Magnifying Glass for use with Midget Bible, **15c**

K.K.K.

Everything about the **Ku Klux Klan** told in a clear, fearless manner. Book tells all How it started and was suppressed in 1871—The New Ku Klux Klan—How organized—How members are enrolled—Oath of the Klan—**Questions for Candidates**—Creed—Objects of the Order—Obedience—Fidelity—Pledge of Loyalty—**Ku Klux Klan and the Masons**—The Jews—The Masons—Real K. of C. Oath—The Negro Ku Klux Klan, etc., etc. Latest and most complete book on the Klan published. **Price, 35c,** postpaid.

SEX INDICATOR

Hold the **MAGIC INDICATOR** over a man's hand—instantly it moves in a straight line, backward and forward. Hold it over a woman's hand and it describes a complete and continuous circle. The same action can be obtained over a letter written by a man or woman, etc. It is fascinating; baffling. We have never been able to figure out how it's done—but we've never seen it fail. Many novel and entertaining feats may be performed with the Sex Indicator. For example, similar results can be obtained with animals, cats, dogs, rabbits, over birds, chickens, canaries, etc. Also used to predetermine the sex of chickens and birds, etc., in fact it is sold as a patented egg tester in Europe. **Price 25c, or 3 for 65c, postpaid.**

STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous by flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. **Prices, postpaid: 40 Bills 20c, 120 for 50c, or $3.50 thousand postpaid.**

Wonderful X-Ray Tube

10¢

A wonderful little instrument producing optical illusions both surprising and startling. With it you can see what is apparently the bones of your fingers, the lead in a lead pencil, the interior opening in a pipe stem, and many other similar illusions. A mystery that no one has been able to satisfactorily explain. **Price 10c, 3 for 25c, 1 dozen 75c. Johnson Smith & Co.**

Good Luck Ring

Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

Exploding Cigarettes

JUST LIKE ORDINARY CIGARETTES. BUT SUCH REAL STARTLERS! The box contains ten genuine cigarettes of excellent quality. They appear so real, but when each cigarette is about one-third smoked, the victim gets a very great surprise as it goes off with a loud **BANG!** A great mirth provoker yet entirely harmless. **Price 25c per box.**

Popular Watch Charms

15c

BIBLE

3 for 40c; $1.35 doz.

Very pretty little curiosities and decidedly novel. Fitted with Magnifying Lenses that enlarge the pictures to a very surprising degree; in fact, it seems almost incredible that a clear picture could be possible in such a small compass, and how sharp and distinct they show up when you look through. Come in assorted views—Actresses, views of Panama Canal, Lord's Prayer in type, etc.

CIGARETTE MAKER

Roll your own and save money. Makes them better and quicker besides saving more than half. Use your favorite brand of tobacco. Neat, useful and handy. Pocket size, weighs ½ oz. Made entirely of metal, nickel-plated. **Price 25c postpaid.**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

Post Paid 25c

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it which, when once acquired after a little practice will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is so charming as it is surprising.

Novelty Badges

Kissing Permit 10c *Garter Inspector 10c*

Two very novel metal badges, nickel plated, that you can wear, giving you fun out of all proportion to their trifling cost. **10c, each badge, 3 for 25c, or 75c per doz. p.pd.**

BLANK CARTRIDGE PISTOL

Price $1.00 Postpaid

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid women can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against** Burglars, Tramps and Dogs. You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of solid Metal. **PRICE ONLY $1.00 Postpaid. Blank Cartridges 22-cal. shipped by express only, 50c per 100. Johnson Smith & Co., Dept. 367 Racine, Wis.**

Sneezing Powder

Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it one from the other. Between the laughing and sneezing you yourself will be having the time of your life. For parties, political meetings, car rides, or any place at all where there is a gathering of people, it is the greatest joke out. **Price 10c or 3 for 25c**

Mystic Skeleton

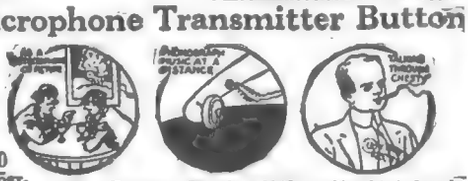
10c ppd.

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements that the operator may be some distance from it.

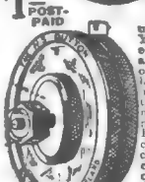
Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most life-like manner. **Price per box 10c ppd.**

Microphone Transmitter Button



$1.00 POST-PAID

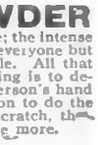


You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in micro-phones. You can mount the button almost anywhere—card board boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifier radio signals. Countless other similar uses will suggest themselves. Experimenters find the Button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. $5.00 is given to anyone who sends in a new suggestion for the use of the Button providing the manufacturers find it suitable for use in their literature. **PRICE $1.00 POSTPAID ANYWHERE.**

ANARCHIST BOMBS

One of these glass vials dropped in a room full of people will cause more consternation than a limburger cheese. The smell entirely disappears in a short time. **10c a Box, 3 Boxes for 25c**

INVISIBLE INK



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Transmitting Pictures by Wire and Radio

By BERTHOLD FREUND

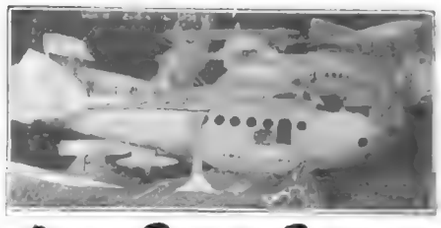
(*Continued from page 787*)

transmission range of the wireless picture transmission compared to that of the Telautograph is very limited. Of course it involves the reception and reproduction of extremely fine changes in intensity of the wave energy in which the receiving station must exactly reproduce. Atmospheric and other disturbances play an important part here.

The last named intermediate cliché method, possesses over both the methods just spoken of the advantage that no synchronizing apparatus is required, and the picture goes on in the form of a common typed telegram, and is received as such. The picture can, therefore, be reproduced in the progress of work at any desired time. A further advantage appears in this method. It requires no interruption or disturbance of the normal telegraphic operations. During the telegraphing, transmission in the opposite direction is possible and no picture transmission plant is required at the radio station. But here comes a disadvantage. For the preparation of the intermediate cliché, a period of time which may be one or several hours, is required for its preparation, and morover the time required for the telegraphing and the expense of telegraphing is proportionately high, and much time has to be expended at the receiving station for the reproduction of the picture. A picture transmission system which shall suffice for the requirements of practice, in reference to quality and economy, must unite the advantages of the above three systems in his own apparatus.

In working out this question to which I have devoted myself, I succeeded by the use of a new transmission process for pictures invented by myself, to reach almost the requirements indicated above. The new system for which patents have been applied in all civilized countries, and whose technical arrangements are protected by special patents, provides—and it is especially adapted for wireless telegraphy—a direct phototelegraphic process—a process in which the picture to be transmitted is put at once into the transmission apparatus, in which it is treated on the line system in the photoelectric way and is reproduced directly at the receiving station. The transmission of the tone values of the picture in the new process is not affected as in the hitherto direct photographic processes by currents of varying intensities, but by automatically controlled current pulses of constant intensity but of varying duration, all affected by the tone values of the picture. Every point of the picture for example in this way can give a telegraphic signal of definite length, so that the length of these signals is a measure for the tone value. These current or telegraphic impulses are of the same nature as the telegraph signals of the old telautograph symbols written on metallic foil. At the receiving station in the new process the incoming telegraphic impulses are not repeated as in the telautograph as black and white symbols, but immediately give the proper tone values fixed by photography.

The process alluded to are carried on at the sending station as well as the receiving station entirely automatically, and with extraordinary rapidity, so that the transmission of the picture at very high speed is possible. A quantity of specifically technical details prevent all disturbances of the processes. In consequence of this the principles of the new picture telegraphy only briefly described here, has a large number of technical and economic advantages over the apparatus hitherto employed.—*Die Umschau.*



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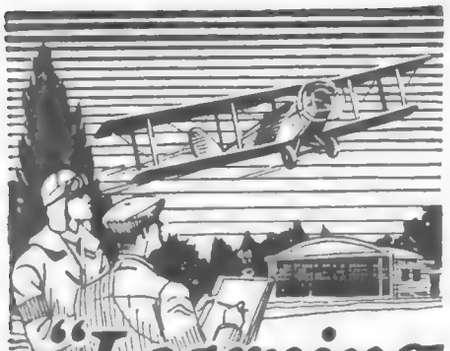

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How Cast Iron Radiators Are Made

(*Continued from page 785*)

MAKING SAND CORES

The sand cores, similar to all molding cores, are interesting in that they consist of nothing but clean white sand, mixed with a little core oil (mostly linseed oil) and water, the proper shape being given them by packing in iron molds the shape of one-half a radiator section, with gas vents inserted as indicated in the illustration. The molten iron always finds something to burn in the sand, and the gas of combustion must escape. From the core molds the sand cores go to the core ovens, in which they are subjected to a baking temperature for several hours. When baked they are good for a number of weeks. When the mold is poured the core holds its shape until the iron begins to chill or set, which takes but a few minutes, and the core then disintegrates.

The molten metal is run into ladles lined with fire clay, and each molder carriers his own ladle. The average full ladle weighs about 70 pounds. This is dangerous work, particularly if a ladle burns through unexpectedly and lets a few quarts of white-hot iron drop on the molder's feet. To provide against this as much as possible the molders are careful about their shoes, off which the hot iron must run readily. It is important that each mold be poured completely at one time, and on large work a big ladle is run from the cupola along the foundry by hanging on an overhead crane.

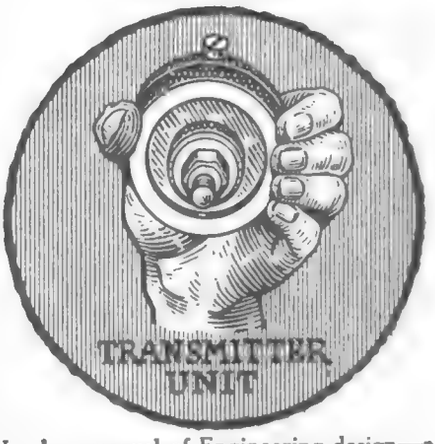
To Readers of
"THE EXPERIMENTER"

You will find the best features of THE EXPERIMENTER preserved in SCIENCE & INVENTION, besides a brand new "Model Department". See the beautiful Silver Trophy cup for best model each month described elsewhere in this issue.

A few hours after the molds are run they may be shaken out. The radiator castings as they come from the molds look rather crude and uncouth, with their dirt, scale and protruding chaplets, which have become a part of the casting itself. The rough castings go to the cleaning room, where all the chaplets and rough edges are chipped off.

After being well groomed in the cleaning room the castings go to the testing department, where they are subjected to a test of 100 pounds per square inch water pressure. If a casting develops any severe leak or manifests a thin wall it is rejected, and the molder is not paid for it. A good molder will not lose over two or three castings a day out of 40 or 50 made. The tested radiator sections are next weighed to ascertain if any of them are running light or heavy. After weighing they are stored in the boring mill room, where they are bored as required. The boring mills are specially built machines capable of boring at one time all four of the 2-inch holes in the four hubs, two at the top and two at the bottom, of a center hot water section. If the radiator is to be used for steam only, the bottom hubs are connected by tapering push nipples of steel as shown in Fig. 8, or if for hot water heating the top and bottom hubs must both be joined together by spring steel nipples or thimbles. All the sections for one radiator are arranged on the bed of a hydraulic or screw press, with spring steel nipples in every bored hub, and then the whole radiator is literally pushed together. The stay bolts reaching through the whole set, one at top and one at the bottom are then inserted and tightened. A finished radiator is the result.

Thousands Use These Ingenious TRANSMITTER UNITS



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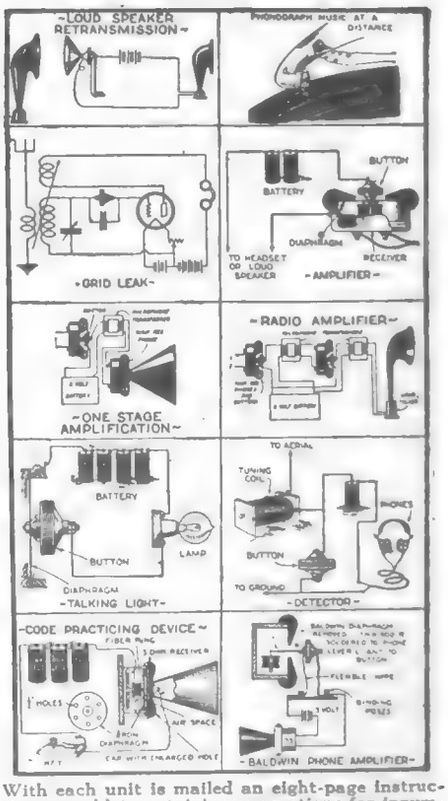

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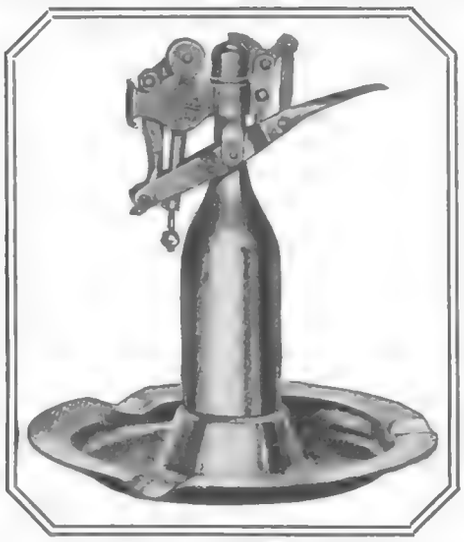

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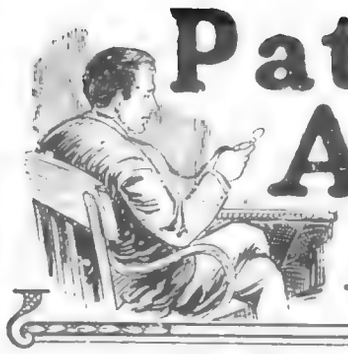

Edited By
Joseph H. Kraus

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

ANTI-SKID DEVICE

(984) R. P. Smith, Orange, N. J., has submitted a design for a sand distributing device to prevent skidding of automobiles on wet and icy pavements.

A. In regard to your proposed type of device for preventing the skidding of automobiles, we would advise that the idea is very old and has been proposed several times in the past. We do not consider it to be at all practical. There are a good many objetcions to it in connection with autombiles and not the least of them is the fact that in winter, when a device of this nature would be most desirable, water and ice collect along the lower edge of the running-board and would render the operation of a sand-distribution device impossible. Furthermore, such a device would require constant attention and would need frequent refilling. However, the feature mentioned above regarding its non-operation in winter weather would be enough to preclude the possibility of making this system practical and, therefore, we would not advise you to prosecute it further.

ASSIGNMENT PATENTS

(985) Arthur J. Shaukis, Haverhill, Mass., requests information concerning assignment patents on tire treads.

A. Evidently the designers of the treads were members of the organization to which the tread designs were assigned. Thus, if the Western Electric Company desires to obtain a patent on one of the inventions developed by one of their many employees, a patent attorney is given all the details concerning the invention and naturally the man actually developing the idea takes out the patent. But the Western Electric Company pays for all patent costs and the patent is automatically assigned to that company. The men employed are there for the purpose of inventing and are paid for this work.

Assigned patents are not necessarily always assigned to a large organization. If I were to employ you to make a design for Tire Treads for me and I had a market for those designs you would have to assign your patent to me while in my employ and then I could sell it to any organization at the price I desired.

CAM SHAFT

(986) W. D. Kippal, Huntington Beach, Calif., claims to have made a number of cam shafts of his own design which were used on racing cars with remarkable results. Quieter operation, no breaking down and slower throttle are some of its features. He asks our opinion of the idea.

A. We regret to say that we cannot advise as to the patentability of your improved cam shaft design unless you desire to submit full details regarding the same. However, if this cam shaft operates as well as you describe we would certainly suggest that you proceed to protect it by means of a patent.

Before doing so, however, engage some reliable patent attorney, such as one of those advertising in the pages of this magazine to conduct a patent search for you. There is a possibility that there may be cam shafts similar to your own in design, that have been patented. Such a search will reveal these devices. In the event that nothing is found that would prevent you from obtaining a patent, we would advise you to proceed toward this end immediately.

After the patent has been issued or even after the application has been filed in the Patent Office you can proceed to take up the matter with some large manufacturer of automobile engines and attempt to sell them the idea outright or upon a royalty basis.

INDOOR GOLF GAME

(987) Edward Skinner, Detroit, Mich., has designed an indoor golf course and requests our opinion on the same. Inasmuch as the idea is worthwhile its details are not disclosed.

A. We are of the opinion that your indoor golf course is patentable and undoubtedly you would not find it very difficult to market the same.

The game seems quite unique and if sold at a reasonable price would undoubtedly find a market. As to whether or not it would pay you to patent the game would depend largely upon your ability to finance, advertise and sell it. It may be quite a hit. On the other hand, it may not be looked upon with any degree of favor whatever. There being over a million golf enthusiasts in the United States, it might be worth while to tackle the venture.

GAS TANK CAP

(988) Henry Schnitzler, Batavia, N. Y., submits an idea of a gas tank cap which lifts to one side and snaps back in place after the filling hose is removed.

A. There has recently appeared on the American market a tank cap for automobiles, which instead of lifting off and flying shut as indicated by you, contains a spring and a round ball-like structure, so that it is only necessary to push the nozzle of the gas filling hose down into the top of the cap. This forces the ball to one side, permitting the entrance of the funnel. The ball again automatically snaps into place the instant that the nozzle is removed. Unfortunately, this type of radiator cap has not made any great success, and it is doubtful if a spring type will be looked upon any more favorably.

The spring type of radiator cap presents a slightly better device than the one with the ball, because in the latter style a slight accumulation of dust on the surface would (unless it were wiped off beforehand), find its way into the gasoline. This defect would be impossible with your spring cap.

We would suggest that you have a patent search made on the idea, and if it has been previously protected or if a similar scheme has been protected, we would advise that you forget about the idea entirely. It is obvious that a radiator cap, if slightly changed, can also be used on the gas tank.

INVENTORS PROTECT YOUR IDEAS

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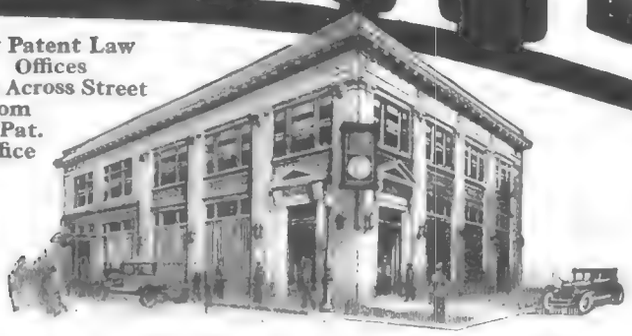

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Home Mechanics

By W. M. BUTTERFIELD

(*Continued from page* 809)

7 inches long ¼-inch thick and 2 inches wide. Fasten with screws and glue, each end of the cleats placed 1 inch from the edge of the lids.

A handle (D) is used on the cabinet, it is 15 inches long and 4 inches wide and cut out of the 1-inch lumber. It has an ornament 3 inches long secured with a dowel and glue to the handle. This ornament is 1¼ inch in diameter and is turned from the 1½-inch stock. The handle is secured to the frame (A) with four screws and glue.

In assembling the parts the frame is first glued together, all parts having been fitted before gluing. This includes the holes for the leg-dowels and the screw holes for the leg screws with proper fitting. The leg, brace and foot parts undergo this fitting process at the beginning also and are next assembled. When both groups are dry enough they are put together, using glue between all parts of the legs touching the frame, and with the screws and washers. After drying put in the end pieces, fitting them over the leg screw washers by cutting away where necessary. The ends may be glued to the inside of the frame. The corner pieces (F) are next put in place, cutting being required around the washers for the lower pair, as in the case of the ends. These corners are glued on as well as being secured with screws.

The side pieces (G) are next put on, the holes for the screws holding them having been bored and countersunk. When the sides are on the bottom (G) is put in and fitted. Both ends of this bottom rest on a lower corner piece (F) and can be secured to it with a screw for each end of the bottom. The handle (D) is next put on, using glue and screws. The cabinet now roughly glued together is smoothed and sandpapered. The lids (H) are next fitted, smoothed and sandpapered.

The next move is to stain, rub down and varnish the outside and inside of the cabinet. Maple does not look badly with almost any stain or finish, but it is usually stained lightly so as to show the wood and grain in its natural color. This stain is a light coffee-color, probably raw sienna was used by the old makers.

TOOL LIST

The tools required for building the Priscilla Sewing Cabinet will vary with each mechanic perhaps, but he will find handy a good crosscut saw, small smoothing plane, compass or keyhole saw, large hand drill or brace and set of bits, several sizes of wood chisels, rabbiting plane, and sandpaper both fine and coarse.

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Into the Fourth Dimension

By RAY CUMMINGS

(*Continued from page* 803)

from its physical shell which it then leaves behind—is gone forever. Yet that too, is illogical, for traversing a curved path such as ours—however slight may be the curve—one must eventually return. And out of this we have built a theory that such a mind—or as we call it, an Ego—untrammeled—will return sometime to take a new body. But I must not confuse you with mere theories when there is so much of fact which is confusing enough no doubt."

"That's not confusing," said Will. "We likewise have such a theory—we call it reincarnation."

Thone went on: "We have then, a void of curved Space. Within it exists Thoughts; material entities persisting in Space for a length of Time. Thus Time is brought into our Universe; but not Time as you have described it to me. Ours, like yours, is the measure of distance between two or more events. But the distance is very dimly perceived by our senses."

"Wait," said Will, "Before you discuss Time, let me understand the other. All your material entities are Thoughts? That is incomprehensible to me."

Thone explains the new land.

Thone deliberated. "I suppose that is natural," he declared at last. "Your substance—as it appears to you—has a greater solidity than the substance of your mentality."

It was Will's turn to smile. "The latter, with us, has no substance at all. The human mind—as distinct from our physical brain—is wholly intangible. And it is one of the things we know least about."

"Perhaps that is why it seems so unsubstantial," Thone retorted. "At all events, with us mind-qualities are the basic substance out of which all matter is built. A variety of qualities, evil and good, which vary the resultant product, be it an Ego, or a thing inert, all are from the same source—a thought."

A Universe built from a Thought! Yet to Will then came the realization that our realm is of an essence equally unsubstantial—our own matter—rock, metal, living organisms, what are they of their essence save a mere vortex, a whirlpool of Nothingness?

A question came to Will; and even as he asked it, he knew its answer. "Your Universe built from a Thought? Whose thought? You start with Nothing, yet you presuppose the existence of a Mind to think that thought."

"A Mind All-Knowing," Thone answered very slowly. "A mind Omniscient. Have you not spoke of your own belief in such a mind? We call it our Creator-Mind—as quite literally it is."

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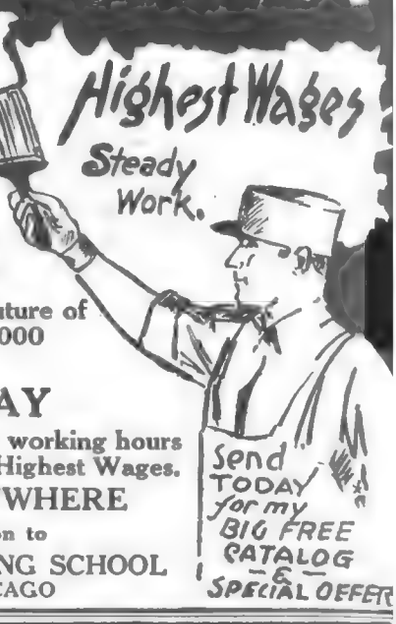

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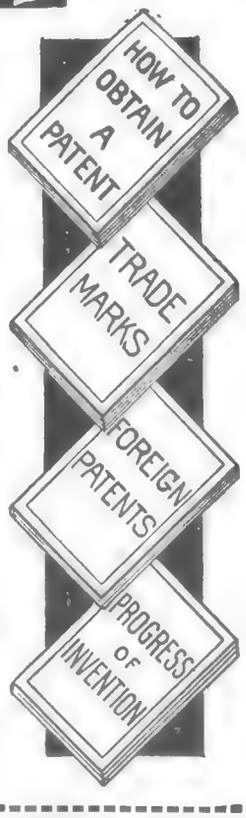

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"Theology," Will said, "Of itself; that is not concrete to me who am in a measure of scientific reasoning. You cannot build Science upon Theology."

Thone said warmly, "Ah, but you can. That is where you of your Earth—as you call it—are wholly mistaken. And indeed, I begin to see where there is not so much difference between your world and mine as we suppose. Let us assume we have the same Creator, His thought to bring us and all that we call our Universe into being."

"Granted," said Will. "But there—with a theological assumption—the similarity ends. You start with a Divine Thought? We start—"

"With what?" Thone demanded.

"Scientifically speaking," Will answered lamely, "we have no beginning. At least, we have not yet been able to explain it."

"We then are more logical than you," Ahla put in with a gentle smile.

"Perhaps," agreed Will. "But you cannot connect your Divine Thought with your Science—or at least you have not, to me as yet."

"But I will," declared Thone. "We take this Thought-Divine and find it to be a vibration of Nothingness. Of what is your basic substance composed?"

"The same," said Will.

"Quite naturally. We are then of a similar origin—constructed only to a different result. Our substance, in its final state, remains to our consciousness a vibration of Thought. It is quite tangible. Let me show you. Touch me—Your hand feels me? That is the physical—cohesive Thought—matter, persisting in Space and Time throughout my existence. Distinct from that, there is my material—mentality. It also persists in Space and Time, but to a lesser degree. More transitory. More varied in its outward qualities, since I can fling out thought—vibrations of good or ill—of many kinds and types.

"Understand me, my friend. This is Matter of temporary duration which I can create myself at will. Or—in terms of your own realm, if you prefer—I can set into vibration, into motion, intangible matter already existing, and by its very motion bring it to tangibility. Can you understand that?"

"Yes," agreed Will readily. "And you surprise me with constant similarities to my own world. We believe our own thoughts to be vibrations of some substance intangible. And when you speak of creating an appearance of substance by imparting motion to something otherwise unsubstantial, that too we see in our world. Water is a fluid. A stream of water slowly flowing from a pipe offers no solidity to a blow from a rod of iron. But if that water comes from the pipe

Articles In January "Radio News"

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with a swift enough motion, a blow struck against the jet with an iron bar seems to be repulsed.

"That seems not actually the creation of new matter, but we have another effect which is this. A tiny rod of steel—a needle the length of my finger—may hang motionless balanced upon a pivot. It is a material body we would call three or four inches long, by one-hundredth of an inch thick and broad. We set it swinging—vibrating—whirling in a circle with the pivoted end as the center. With a swift enough movement that circle is impenetrable. In effect, out of that needle, we have created a steel disc, one-hundredth of an inch thick, with a diameter of say eight inches. An area of material substance hundreds of times greater than the needle—yet the mass is not increased."

"Quite so," Thone agreed. "Our thought-waves have a mass infinitesimal. But like your steel disc, they can momentarily become very tangible to our Ego-senses. A tangibility very different, yet comparable to our bodies themselves. Less mass, yet more power. Under some circumstances they may alter an inert substance, as I have made transparent to our vision that segment of the globe over there, beyond which we see the

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city. Or they can enmesh a material organism—your body, for instance—I had meant to demonstrate that."

He moved away from Will, stood quiet; and about Will he flung his wave of thoughts, so that Will was drawn irresistibly to him—as Bee and I were even then enmeshed by Brutar's thought-substance.

Thone laughed. The net of his thoughts dissolved. "You see? It is a very tangible substance. Yet elusive as well. We understand partially its uses. Yet only partially. Its nature is varied from a tenuosity impalpable, to the physical substances which form the entities of our universe. Like that thing you described as your Light-waves, our Thought-substance can traverse Space with tremendous velocity. Not a finite, measurable velocity, as with your Light, but with a speed infinitely rapid.

"A thought may travel to infinity and back in an instant. That—understand me—relates only to its most tenuous form, impalpable to our physical senses—perceived only dimly and only occasionally by a mind other than that from which it originates. In more solid forms its velocity is slower. But it is all under control of our Ego-will power. Do I confuse you?"

"A little," Will admitted. "I am trying to hold a clear conception of it all. I understand you have a void of Space. Must it not be filled with something besides these Thought-entities? Some all-pervading, impalpable fluid?"

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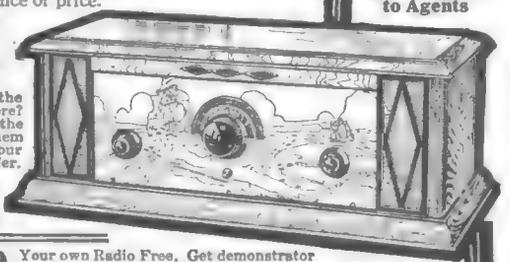

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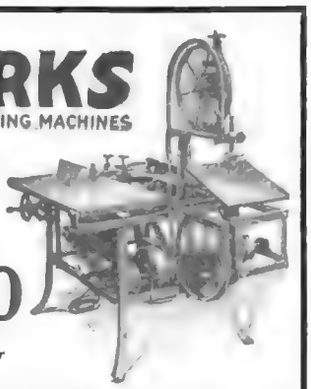

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"We do not know," said Thone frankly. "There are emanations from our immobile organisms. Thus we breathe and eat—the substance of our bodies is renewed—but of that I shall tell you more at another time. You were saying—"

Will went on: "This realm then is filled with your material bodies. This globe we are in—the globes that make your city—the Ego which is you—and myself—other Egos like us—What holds us where we are?" He smiled. "I'm groping, I'm trying to say, is there no gravitation? No gigantic material body holding us where we are. Out there in the open—" He gestured. "We walked upon something. A surface—a slope. What is it?"

"You ask me many questions at once," Thone replied quietly. "Gravitation, as you call it—yes, with us it is the inherent desire of every particle of thought-matter to cling to its fellows. Thus everything of substantiality tends to cluster at the center of the void. Only motion enables it to depart, which is why it must always move in a curved path—a balancing of the two conflicting forces.

"You question me about some gigantic material substance—like your Earth. There is none. You asked me upon what you walked out there in the open. You walked upon the curvature of Space. Upon a false, a mere semblance of solidity which was the resultant balance of the forces moving you. This globe—this city—it lies immobile upon a solidity equally false—immobile because there is nothing to move it."

"I think I understand a little better," Will said slowly. "All force then, as well as all matter, has its source in the Ego-mind."

"Of course. We create matter, and movement of matter, by our own volition. We have been originally created by the Divine-thought; after which we construct and maintain our Universe by Ego-thought of our own. Inert substance—the mind laboriously creates it; flings it out, solidifies it, moulds it to our diverse purposes. Living organisms—the reproduction of the Ego-species—is similarly of our Ego-mind origin. Yet there is a difference there. For me to reproduce myself in Ahla, the Divine-Thought—the assistance shall I say of the Great-Creator—again is necessary. We have not been quite able to fathom why it is so—but it is. There is a difference between an Ego and a thing inert—a vital something which only the Great-Creator can supply.

Ahla suddenly interrupted; and upon her face I saw fear. "Your friends—those whom you called Bee and Rob—they are in danger. She—that girl as you called her—

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that girl Bee—is sending out thoughts of danger. I can feel it."

Thone said: "Try, Ahla—could you find her? Where has she gone?"

"I don't know. Her thought-matter is streaming back here. I can feel it—very faintly—but it has reached here. She is with Rob—and there is Brutar."

Thone was upright, with Will beside him. Will was surging with fear. "Danger to them? To my sister—to Rob—"

Thone said: "He has entrapped them—Brutar has entrapped them—all unwary since they do not know how to use these new minds which are themselves. We must try and get them—Oh, my friend, there is so much that I would tell you—but another time—not now. For if they are in danger we must go to them. That Brutar is a Mind very powerful.—"

And out there in the void, Bee and I were being rushed onward. The shape of Brutar with his leering, triumphant face swept ever before us. A dark confusion of mental chaos plunged past. Dismembered, leprous shapes of things, which I thought I saw.

Was this insanity? I heard Bee babbling. Felt that evil engulfing net around us—pressing us—dragging us through the darkness—

Then abruptly the scene clarified. The darkness melted before a luminosity so blessed I could have cried aloud with the relief of it. The leprous shapes were gone. Motion stopped; we were at rest, with the net of Brutar's thoughts dissolving from us. Rationality. Again I could think things which were not diseased.—

I murmured: "We're all right, Bee. You—you are well again?"

"Yes, Oh, yes, Rob. But I'm so frightened."

Brutar stood before us. "I need you—I am fortunate to have you here. You whom they call Rob—with your knowledge of that Earth-place, you can be of great help to me."

He swung toward Bee. "You whom they call a girl—" His twisted look was horrible. "I am glad to have you. We shall go to your Earth together—I welcome you both to this place where we are preparing for our great Earthly conquest."

He led us down a slope, into the strange activities of his encampment.

(END OF PART V)

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WHY NEW YORK EDISON PLANTS STAY IN CITY

By ARTHUR WILLIAMS, Vice. Pres.

THE question is frequently asked, why are the great New York Edison power plants—consuming hundreds of thousands of tons of coal yearly—not located at the mine, thus avoiding long distance transmission of this enormous volume of freight and lessening the crowded conditions at New York's freight terminals? In a recent article in one of the great dailies, describing their new East River plant, a distinguished writer stated, "The Edison engineers must have a good reason for placing these plants within the city's limits, though it is difficult for others to understand what justification might exist for this reason."

There is still another reason, which but needs be told to be understood. A modern power plant, such as we have here, requires great quantities of cold water for condensing purposes, and as a rule, there is at best a very limited supply of water in the coal fields. Probably few realize the magnitude of the volume of water used in these plants. For the purpose of steam condensation, each ton of coal requires 700 tons of water. The pumps of these waterside plants are capable of supplying 2,700,000,000 gallons daily, or three and one-half times the amount of water consumed by the city for drinking and all other purposes. This, however, is not the water we use for drinking; it is water borrowed from and returned to the East River.

Without referring to the availability of competent and experienced workers required to operate these plants if located in the coal fields (for this, taken by itself, could probably be adjusted), there is still another reason which makes the location of huge power plants in the mine fields, of most doubtful desirability. Their supply of fuel would thus be confined to a single mine, or group; if shut down all electrical service to the city would be cut off. At the present time the New York Edison Company is receiving coal by rail and water from nearly 30 mines, and has also available the foreign markets from which it has already drawn coal for the protection of the city's electrical service several times during past years. Constant availability of an adequate and diversified fuel supply is one of the essentials first considered in determining upon the location of a modern steam power plant.

It will be seen then, that there are three or possibly four controlling reasons for the present engineering practices of the company in this respect; the security of the service, the need for enormous quantities of cold condensing water, the availability of fuel supply from a number of different sources and, possibly, as an additional though adjustable condition, the availability of a sufficient force of competent workers living near well conducted schools for their children, in comfortable homes and under enlightened social conditions.

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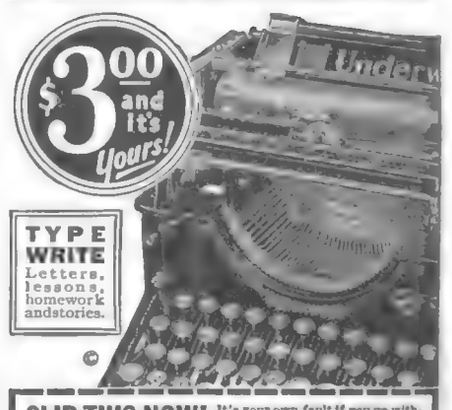

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Our Spiritualistic Investigations

By DUNNINGER

(*Continued from page* 805)

high, but seemed to be about four feet square. A quick glance showed that the cabinets were both constructed of gas-pipe frame work, with curtains made of heavy texture material hung about them. Five or six cane chairs, of ordinary type, stood vacant beside the cabinets. Mr. Brockman offered a rather lengthy lecture upon spiritualism, which consisted mostly of laurels directed at his wife's ability. He admitted that there were many fraudulent mediums, some of whom had attempted to duplicate his wife's miraculous performance, but none of whom were able to duplicate a similar effect, under which Mrs. Brockman was to illustrate her psychic ability. From his lecture we further gathered that Mrs. Brockman was the only medium in the world who could produce natural, living things, from out the spheres of the great beyond. The lecturer was not quite descriptive in all he said, but I further gathered that the spirits were to assist Mrs. Brockman, by bringing her the souls of animals, flowers, and the like, which, as I understood, she was to produce in natural form, through a power which she alone possessed. To emphasize her unique ability, the talkative gentleman informed us further that this lady had mystified the greatest of scientists. After an hour I felt sure that the majority of his listeners were prepared to see the eighth wonder of the world. And so, with extended hand, and a graceful bow, he introduced Mrs. Brockman, who was seated among the audience in the first row. She arose from her seat, and managed with difficulty to walk up the small set of steps to the side of the platform, assisted by her smiling husband. Applause greeted the medium, who walked toward the center of the stage, with a smile broadly affixed upon her countenance, overflowing with confidence. Mr. Brockman now invited a committee of ladies or gentlemen upon the stage to see that everything was genuinely presented. With some apparent coaxing, several would get up here or there, and start for the steps. Seven women, and three men, were finally persuaded to act as a committee of investigators. The lecturer extended another invitation to the scientific minds, to step up and partake in the examination of the medium's powers. So we were supposedly to take the matter for granted that the three gentlemen upon the platform were our scientific representatives. A young lady in one corner of the hall, favored us with an organ recital, while the gentleman proceeded to prepare for the test. The ladies upon the platform escorted Mrs. Brockman into the larger cabinet, the

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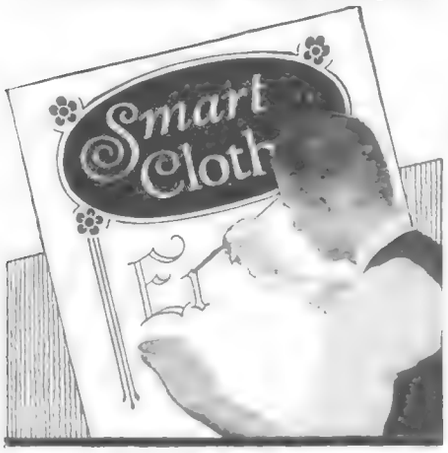

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curtains of which were drawn aside, to permit her entrance, and were then closed by the careful hand of our little lecturer. Several moments elapsed, when the curtains were once more opened, Mrs. Brockman stepped forth attired in an all black one piece bathing suit. The ladies followed, and grouped about the medium. The music ceased, and Mr. Brockman once again proceeded to explain things. Mrs. Brockman had been examined by the female committee. who disrobed her, and were prepared to vow that they were sure nothing was concealed about the person of the medium. Inspection of the smaller cabinet was now invited, and this structure truly had all the appearance of innocence. I was convinced there was nothing concealed about this cabinet. The examination by the committee seemed fair, and two or three apparently more or less inquisitive spectators, uninvited, made their way upon the platform. I was among them. One of the cane chairs was placed to the center of the cabinet, and the medium took a seat therein, filling it comfortably. Two lengths of rope, some eight or ten yards each, were handed to the gentlemen, who were requested to tie the medium to the chair. This was rapidly done. The medium now entered a trance, as we were informed. More organ music, and the mystic went to sleep. Silence was requested. Another examination of the cabinet was invited, and one of the gentlemen, and three of the ladies looked about, lifted the curtains, and assured of the genuineness of things, stepped out of the cabinet, the curtain of which was rapidly closed by the lecturer. A few moments elapsed, when a fluttering was heard inside the cabinet, and a large, white pigeon flew out of the top of the structure. A moment or two later, a white rabbit managed to wiggle its head from beneath the curtains, and came hopping forth. Another pigeon soon made its appearance . . . then another rabbit. This proceedure of managerie production continued, until four pigeons and three rabbits had joined our festivities. The curtain of the cabinet was slowly drawn aside, and there sat Mrs. Brockman, covered with flowers. Roses, carnations, asters, et cetera.

The medium, with sleight moans, and apparent pain, soon came out of her trance. She seemed exhausted. She was unbound, and assisted into the larger cabinet, where she proceeded to dress. The seance was over. The music swelled, as the amazed onlookers marched out of the hall, bewildered by what they had seen. Mr. Brockman, with one assistant, was stationed on either side of the door, and passed out cards.

The animals and flowers could not have been concealed about the medium's body. The examination proved that they were not in the cabinet. There was no trap in the floor of the platform. Where did they come from? That was a mystery, that baffled even the skeptical. Let me not hold you in suspense, dear reader. One of the ladies, who stepped upon the platform apparently as a committee member, was a confederate of the clever team. The animals and flowers were tightly nested into a strong, black, bag, which the lady carried beneath her skirt. A cord to the neck of this bag, held it in place, so that it could be released by a simple pull of this string, which was affixed to her outer waist. After the medium was tied to the chair, and the committee made its last examination of the cabinet, she was among them. She was the last to leave the cabinet, and deposited this "load" upon her exit, as the curtain was being quickly drawn by Mr. Brockman. The medium had but to release one hand from the bindings, which were not over-tightly drawn, in order to open the bag and liberate the live stock. The bag, when empty, required but little space, to be afterward concealed within the bosom of her bathing suit.

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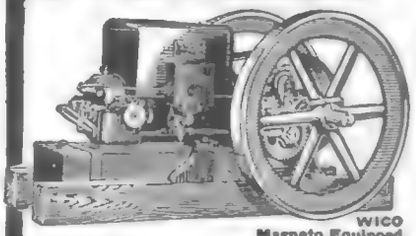

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Building a Good "B" Eliminator

By JOSEPH CALCATERRA

(*Continued from page* 826)

long as it is used with the same set for which the adjustment was originally made.

With this unit a shorter antenna can be used because of the aerial effect in the lighting lines. A slight broadening of the tuning will result if the aerial is not shortened. As a matter of fact in some cases, the aerial can be dispensed with altogether. In such instances the aerial terminal of the set can be disconnected. The ground terminal of the set can be left connected with the ground connection.

With the full-sized panel-drilling template furnished with the kit, the laying out and drilling of the panel used in the construction of the unit resolves itself into a very simple operation.

All that is necessary to locate the holes on the panels is to put some paste on the panel and then place the template on the panel so that the corners and edges of the template line up with the corners and edges of the panel. You can line them up by holding the template and panel up to the light and shifting the template till its edges correspond with the edges of the panel. When correctly set take a centerpunch or other pointed object and "spot" or mark the location of the holes through the template at the intersections of the small crosses shown in circles.

Appearance of latest style "B" Eliminator as furnished complete; ready to plug in light socket, by the manufacturers of the parts here described.

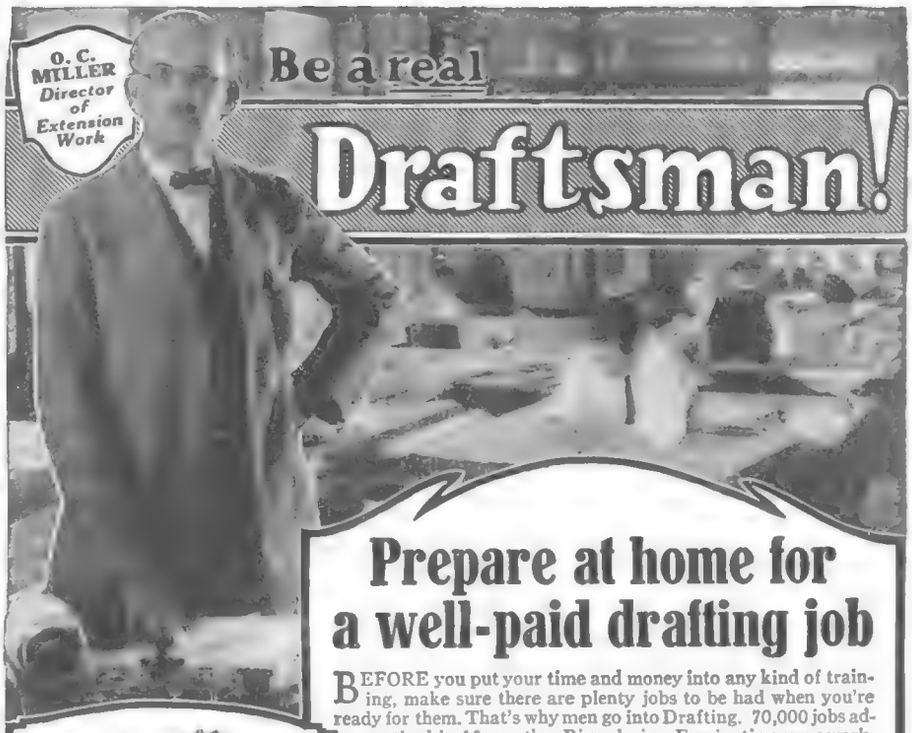
Photo courtesy All-American Radio Corp.

After the holes are spotted, take off the templates and enlarge the punch marks with a small drill about size No. 41. This is done to avoid shifting of the mark later when using larger drills to complete the drilling of the holes. The spot mark is usually too small to center the larger drills.

In drilling holes in panels, always back up the panel with a piece of wood, preferably hardwood, so as to eliminate the chipping on the other side of the panel as the drill comes through. Drill holes carefully. The next operation is to drill and countersink the holes spotted from the template. The hole marked "A" should be drilled with a 7/16-inch drill. All the other holes should be drilled with a No. 18.

TOOL LIST

5 Lengths tinned bus bar wire.
1 Length Kester resin core solder.
1 Soldering iron.
1 Carpenter's brace for holding drills while drilling.
1 No. 41 or 1/16-in. straightshank drill.
1 No. 18 or 3/16-in. bit shank drill.
1 7/16-in. bit shank drill.
1 Pair radio or long nose chain pliers.
1 Pair burner pliers for tightening binding post nuts and holding nuts while tightening screws.
1 Pair diagonal cutting pliers.
1 5-in. screwdriver.



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1 Centerpunch.
1 Hammer.
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You will notice that some holes have a solid line outer circle while others have a dotted line outer circle. The ones shown with a solid line outer circle should be countersunk on the side on which they were spotted, that is the top side of the panel. Those shown with a dotted line outer circle should be countersunk on the opposite or under side of the panel. Be careful in locating the proper holes for countersinking and be sure to countersink them on the proper side of the panel.

All countersinking should be done rather deeply so that the heads of the mounting screws will sink below the surface of the panel.

HOW TO FINISH THE PANELS

After all the holes are spotted, drilled and countersunk, the panel surfaces can be grained and rubbed to nice dull-black finish if that type of finish is preferred to the original shiny black finish.

First sandpaper the panel, in long strokes the full length of the panel, using No. 1 sandpaper for the purpose. After all the shiny surface has been removed, put a little 3-in-1 oil on the surface of the panel and sandpaper with No. 00 sandpaper, until a nice smooth finish is obtained. Then clean the surface with a rag and allow the oil to dry before touching the panel again.

Only sandpaper should be used in these operations. Emery cloth should not be used under any circumstances because emery is a conducting material, which, if it lodges in the panel, will impair its electrical efficiency.

THE CIRCUIT

Do not try to use the ordinary type of voltmeter to determine the amount of voltage across the detector and amplifier terminals of the unit. The type of pocket voltmeter used for dry batteries is not suitable for use in measuring voltages on any of the plate current supplies that are attached to the lighting mains.

When built according to these plans, the unit is very easy to operate and when once properly adjusted there is no hum or noises as a result of using the lighting current. You will actually find a decided improvement in clarity and volume when using this new "B" current supply. This can be readily determined by switching from the new unit to the dry "B" batteries.

RELATION BETWEEN PARTS AND SYMBOLS

In the parts layouts, shown in Figs. 5 and 6 a number has been assigned to each instrument and the terminals of each instrument have been marked to correspond with the markings on the parts themselves.

In the socket three of the terminals, screws (the plate and the two filament terminals) have been reversed to facilitate making connections to them on the bottom side of the panel. The grid terminal is not used at all.

To change the terminals proceed as follows: Remove the "P" and the positive and negative filament terminal screws from the socket. Discard the screws that come with the socket and substitute 5/8-inch 6/32 round head brass machine screws mounting them in the reverse direction with the heads of the screws on the top side of the socket. Before putting the screws in, slip soldering terminals between the head of the screw and the top side of the socket as shown in Fig. 5. This is to facilitate soldering connections to these terminals on the top side of the unit. Then mount the socket in the position shown in Fig. 5 and fasten soldering terminals on the under side of the panel as shown in Fig. 6. All instruments should

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be mounted in the positions shown with heads of screws and nuts on the sides indicated by the top and bottom views of the panel.

After the socket is mounted, assemble fixed condensers 10 and 11 with 3/8-inch 6/32 flat head screws, the heads on the bottom side and the nuts on the top. The mounting lugs on all fixed condensers should be bent carefully to permit mounting of condensers in the positions shown.

The transformer, 14, covers a mounting screw of each of the fixed condensers 8 and 13 so slip the mounting screw on the "A" terminal side of condenser 8 and the "B" terminal side of condenser 13 into place and thread nuts on them on the top side of the panel to hold them in place while you mount transformer 14 on the under side of the panel. After transformer 14 is securely fastened in place proceed to finish mounting condensers 8 and 13, in the positions shown.

Choke coils 5 and 16 are identical in every respect. Take the two choke coils and mount one on the top side and the other on the bottom side of the panel using 3/8-inch 6/32 round head screws with the heads on top side of the panel. Next mount fixed condensers 7 and 18, using the same mounting holes and screws for both.

Mount condensers 12 and 17 in the same way.

Then mount the Bradleyohm, number 6 on the bottom side of the panel as shown.

Place the grid leak mounting clips in position using 3/8-inch 6/32 flat head screws with heads on the bottom side of the panel, and insert the 25,000-ohm resistor cartridge 3, between them, bending them inward sufficiently to hold the cartridge securely.

Next mount the "B Bat. minus" binding post 4 in position placing one soldering lug on the top side of the panel so that it makes a contact with the soldering lug on the grid leak mounting clip and placing another soldering lug on the bottom side of the panel.

Mount the "B Det. plus" binding post number 2 in the same way so that the top soldering lug is making contact with the grid leak mounting clip lug and the bottom lug is in the direction shown. Then mount the "B Amp. plus" binding post number 1 in position with the soldering lug on the bottom side of the panel as shown. Use an extra nut on binding posts to eliminate any chance of their working loose.

The last step in the assembly is to mount the 1 mfd. condenser on the bottom side of the panel using 3/8-inch 6/32 flat head screws with the heads on the top side of the panel. (*When standard "B" condenser block is used, diagram accompanies the block. Photos courtesy All-American Radio Corp.*)

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Beware the Fake Radio Doctor

By HUGO GERNSBACK

(*Continued from page 782*)

are getting bolder, and are beginning to foist various machines under different names upon an unsuspecting public. To be sure, many reputable physicians are using electrical high frequency Faradization and Diathermic machines, which are beneficial in various diseases, but no physician would go so far as to say that such a machine is a radio machine, or that you can be cured by means of radio.

One of the latest attempts to defraud the public by radio is a machine put out by *Dr. Farnham's Laboratories*, located at the Boydell Building, in Detroit, Michigan. A beautiful booklet accompanies the machine, on the cover of which the modest caption, "RADIO APPLIED TO YOUTH, HEALTH, BEAUTY, SUCCESS," appears. The book itself reeks of scientific inaccuracies and highfalutin terms that mean absolutely nothing to the scientist. The following is just a sample: (The Black face type is used to show the absurdities.)

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Marine (or auto) spark coil	2.00
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4 pin jacks at 10c	.40
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not a bad profit to sell $6.80 worth of ordinary material that any one can pick up anywhere, perhaps at a lower price, for the neat sum of $60.00.

Now as to the action of the machine, we found in dissecting it that it is the ordinary spark coil transmitting hook-up, ground and condenser across the gap, but the Farnham hook-up gives no efficiency at all and is, moreover, *wrongly connected*. In other words, even the connections are a hoax.

The reason is simple. In operating the outfit, a small spark is made to jump between the spark gap electrodes, in order to get the usual effect. Even for high frequency electric purposes, the condenser plates are always connected across the spark gap. This the Farnham machine does not do, but connects only one of the plates, *thereby practically killing any electrical efficiency* that the machine might have even as a shocking apparatus. The idea behind the hoax hook-up is that if the machine produced the usual electrification which could be felt, people would think it was nothing but a shocking machine, which, as a matter of fact, it would be if properly hooked up. So, by leaving off the one connection, the Farnham people now make the claim in their pamphlet that "you can not *feel* the current, but you can *see* a tiny spark, if you just touch one plate." This is the usual and typical condenser effect, well known to any school boy experimenter **and the value to the human body is absolutely nil!**

The implication that the Farnham people seek to give the unsuspecting is that, inasmuch as the machine works *apparently* differently from an ordinary shocking machine, or Faradization machine, the gullible will really think that it is the radio current which, so it is claimed, the machine produces, and which effects the cure. In order to "prove" this, it is stated that you can not operate a radio set when Dr. Farnham's Radio Health Energizor is working. That naturally sounds good to the unwary, and, strange to say, this, for once, is a perfectly true statement. And further we will go publicly on record right here in endorsing the Farnham Radio Health Energizor and admit that it produces radio waves. But so does any electric bell in your home. So does your cat, when you stroke its back. So does an electric light socket when you snap the current off and on. So does your telephone receiver when you jiggle the hook. So does your automobile when you start it. So does a passing trolley car, and many others. All of these produce so-called "radio waves," which are nothing but electro-magnetic waves produced in the ether. But you would not think that stroking your cat, or ringing an electric bell, could cure your cold, or your mother's sciatica, or the partial paralysis of your uncle.

Neither, for that matter, does the far-famed Farnham Radio Health Energizor. The instrument, in other words, is a hoax. To cap the climax, Dr. Farnham seems to think that it is the spleen that causes all human ills, and he treats each and every case by applying one electrode over the spleen. A strange world but true.

Now, to get down to brass tacks, I have stated before that almost every electrical appliance in which a contact is made or broken gives out radio waves. This is perfectly true, **but these waves have absolutely no effect on the human organism.** Not so long ago I went to the trouble of finding out if there was any physiological effect that could be ascribed to radio currents as emitted by powerful broadcast and wireless stations.

Science and Invention owns its own broadcast station, WRNY. Its operators are within one foot of *really* powerful currents day in and day out, year in and year out. The plate voltage used on the transmitting

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tubes is of the order of 1450, and the station operates on 500 watts, a sizeable energy. Nevertheless, no *effect* of any sort whatsoever has ever been observed, not only at WRNY, but at any other station. Even the big Government radio station at Arlington, Va., NAA, which operates with a truly great amount of power, namely 27 K.W., upon inquiry state that they have never been able to find the slightest effect upon human beings or upon animals, yet the electrical power used at Arlington is so great that a rubber-tired automobile, when standing under the transmitting towers, will become so heavily charged electrically that if a man coming along touches the automobile, he will get a heavy shock. Nevertheless, not the slightest effect on any one's health about the station has ever been noted.

Gold fish, particularly sensitive to electric currents, have been placed right on top of WRNY's 500-watt transmitter, *within six inches of the full power*, and no effect whatsoever was noted. They were not at all disturbed or affected when the current was thrown on or off at any time.

From this the obvious conclusion must be drawn that any claims that radio can affect the human being, *much less effect any cure of any kind*, whatsoever, must be proclaimed a fake or a fraud, and can not be entertained seriously at any time. Moreover, it is our belief that persons who are trying to exploit the public with the instrumentality of radio are fully aware of these conditions and are, therefore, consciously defrauding the public.

PREVENTING BOILER SCALE

A number of methods are known for preventing deposits on metal surfaces, more particularly the formation of adhering boiler scale, a weak electric current being passed through the metal body. However these methods are not reliable in their effect, and have often been unsatisfactory.

It has been found that the purpose aimed at can be effectively attained if the body to be protected is brought at the same time into a magnetic field, or, should the body in question be magnetizable, a magnetic flux is passed through this body, in which case it is an advantage to vary the direction, continuity and intensity of the magnetic field. This alternating magnetic field interrupts the formation and accumulation of the forming crystals, so that they can only be precipitated in the form of a fine, loose powder. The formation of adhering boiler scale can also be prevented in this way, the precipitating salts falling down in the form of a soft pulp or sludge, which can easily be removed through the openings in the container.

The effect of the magnetic field can be increased by combining it with an additional magnetic field, which is formed by electric currents, that are passed through the body itself.

The magnetic field can be produced for instance by placing electro-magnets at one or more points of the body in question, which is made of magnetizable material, the exciting currents of these magnets being varied in the manner indicated with respect to their direction, continuity and intensity. The magnetization may be effected in any other way, for example by placing the whole body within the range of one or more solenoids.

When treating bodies which are not made of magnetizable material, the devices generating the magnetic field must be constructed and arranged in such a way, that the bodies which are to be protected lie within the magnetic field generated by these devices.

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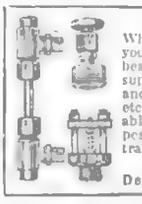

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Wirekraft $3,000.00 in Prizes

(*Continued from page 796*)

The bird cage itself has neither a base nor feeding cups, these being omitted for the sake of the photo. Note how the bars have been practically woven in place by the twisted wire running around the cage. It is obvious that even this cage could be entirely made from woven and twisted wire and not the smallest portion of solder need enter its construction. It is of course easier to solder loops to the cage than to twist the wire. There is, however, always a danger that the soldered connection may become loosened, whereas the twisted wire will never do so.

The construction of the picture frame and the model airplane is quite obvious from the photographs themselves, so we will merely say a word or two about the pile driver toy found on the page of photographs. There are two things of marked importance in this toy. The first is the construction of the gears using only wire to accomplish the result. A disc is first formed and then pieces of wire are cut and soldered to this disc so that they will be equidistant from each other. The gear thus formed meshes with another one made of two smaller discs of the same diameter along the periphery of which strips of wire are soldered.

Another unique point in this construction is the making of the flexible caterpillar chain. This consists of short pieces of wire, tied together with more flexible wire lacings or if the builder prefers, with thin fish line. A chain thus formed may be employed for driving various kinds of machinery of a toy nature. Any form of a working model is admissible in this contest and it should be understood by the builder that if he constructs a toy or a decorative object, he is not eligible for the first prize award, but if his model is considered the best, he may win the second award for those articles possessing artistic merit or for articles coming under the class of models.

The rules of this prize contest follows:

Rules of Wirekraft Contest

THIS is a wirekraft contest. Hence wire is to be used in the construction of all of the models entered in this contest.

The size of the wire to be employed is limited. The heaviest wire must not be larger than No. 8 American or B and S gauge, and the smallest no smaller than No. 30 B and S gauge—or (for foreign countries not having these exact sizes), the nearest available equivalent.

No. 8 B and S gauge is .12849 inches in diameter or 3.264 millimeters. Its nearest equivalent in the Birmingham or Stubs iron wire gauge is No. 18. In the Stubs steel wire gauge it is No. 30; in the British Imperial Standard it is No. 10. The nearest wire to No. 30 B and S gauge which is .01002 inches or .2546 millimeters in diameter is No. 31 in the Birmingham or Stubs iron wire gauge. In the Stubs steel wire gauge it is No. 80; in the British Standard it is No. 33.

The builder may avail himself of the opportunity of using any intermediate sizes of wires between No. 8 and No. 30, B and S gauge.

The wire may be copper, brass, iron, steel, or these materials coppered, tinned, nickel-plated, or galvanized, or the wire may consist of an alloy. Any kind of wire available on the market may be employed.

It is preferable to use non-rusting wires. The publishers will not be responsible for the rusting of any model. To protect wire which rusts easily or for color effects, the models may be painted, lacquered, varnished or otherwise covered.

Any additional decorations or accessories may be employed to enhance the effect. (Example: Silk on a lamp shade; glass in decorative fixtures; electric motors for operating mechanisms, etc.)

Only those portions actually constructed of wire will be judged.

WIRE SHOWN ACTUAL SIZE

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No. 2 - #16 Tinned Annealed Steel Wire, .0625" dia., 40 ft. 20c

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No. 8 #22 Tinned Annealed Steel Wire. 0286" dia. 200 ft. 30c

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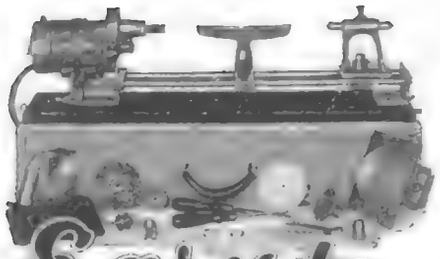

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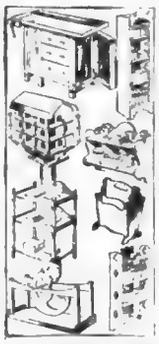

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(Example: A reed basket is suspended from a wire chain. The basket not being made of wire is NOT considered. On the merits of the chain only will the prize be awarded.)

Wires may be twisted, spliced, soldered, welded or bound together. Wire may be used to bind other wires together. If soldered a non-corrosive soldering flux should be employed.

There is no limit to the size of the models which may be entered nor to the number of entries which any maker may submit during any calendar month.

In every case the model must be forwarded express prepaid to SCIENCE AND INVENTION Magazine. It should be tagged with name and address of the maker, who will prepay charges if model is to be returned.

The first prize will always be awarded to a model possessing the greatest utilitarian merits. This must be an object NOT found on the market today.

The second prize will always be awarded to an object possessing the best decorative artistic or constructive effect. It may be a replica of an existing object or a model of an imaginative object or effect.

All models may remain at the office of this publication until the close of the contest at the descretion of the editors.

This contest starts January 1st, 1927, and will terminate January 1st, 1928.

The remaining prizes will be judged from either one or the other viewpoints at the discretion of the judges.

This is a monthly contest lasting for twelve months, each monthly contest closing on the first of the month following dates of issue. Thus the contest for the month of January, 1927, will close Feb. 1st, 1927. Winners for January will be announced in the April Issue.

Address all entries to Editor Wirekraft
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First Prize	$100.00
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Tools Required

THE tools required for the construction of Wirekraft articles may be found in the last issue of this publication, a reprint of which will be sent free upon request. The following tools may be used advantageously:

1 pair flat-nosed pliers. 1 pair round-nosed pliers. 1 wire cutter. 1 hacksaw. 1 small vise. 1 soldering iron.

The materials which are necessary are:

Solder, soldering paste or flux, nails, one piece of wood, and most important of all, wire of the sizes specified in the contest rules and regulations.

If the builder decided to weld his wires together, a small welding transformer or a storage battery may be used for this purpose. For the formation of long cylinders, a coil winding machine or a lathe may be advantageously employed. Toy motors for the operation of any devices constructed of wire could of course be procured and added to the model and the addition of miniature sockets and bulbs to illuminate the interior of any buildings constructed of wire might also find a place in some of the constructions.

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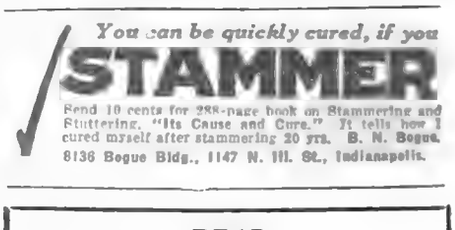
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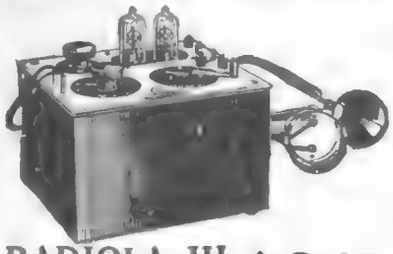

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Motor Hints

By GEORGE A. LUERS

(Continued from page 801)

METHODS FOR PROTECTING THE ENGINE AT HOOD AND RADIATOR

The retention of engine heat, is essential for winter operation. If the engine is run at a low operating temperature, the cylinders will misfire, the spark plugs will foul and the combustion chamber becomes oil fouled, and much dilution of crank case oil occurs from the gasoline, in unfired charges, getting past the pistons.

The usual type of radiator and hood cover is objectionable, first because of the damage which is done to the paint, second it detracts from the appearance of the car and third it interferes with the lifting of the hood.

Protection without these objections, is possible with sheets of red or black fiber board, which is almost as stiff as metal.

This material can be fitted to the inside of the engine hood, over the slits or lourves, and two sections fitted, each one to cover one-half of the radiator.

Use the turn type of curtain fasteners, placing the turn pieces in the radiator and inside the hood as shown in the sketch. Place the eyelets in the covers, spacing them to have the fiber fit close.

These covers become a permanent fixture, to be removed in warm weather. The front radiator part is black enameled, or it is enameled the same color as the car.

THE STORY THE RADIATOR THERMOMETER TELLS

When conditions are not just right under the engine hood, the telltale thermometer indicator on the cap of the radiator, is the usual means of signaling this information to the driver. Not all indicators are located of course at this exact position, for some cars are equipped with dashboard indicators.

The driver immediately knows that the engine is hot and the radiator is boiling or nearly so. If driving through deep snow. heavy mud or up mountainous roads, the driver anticipates this, otherwise, there exists a mechanical fault or other disorder which should be corrected.

To simplify the work of detecting and investigating, the diagram on page 801 will be found an advantageous guide.

Readers Forum

(Continued from page 821)

of another glacial period because that condition in all probability will never be repeated. Most people, when the sun sets at night never even give the matter a thought about whether or not it will rise the next morning, but in other matters where there really is just as much certainty, they have no faith whatever.

E. E. BEEMAN,
Elmira, N. Y.

(We thank you for your letter and are glad to publish the additional data which your interesting brief has brought forward.—EDITOR.)

MAKING TELESCOPES

Editor, SCIENCE AND INVENTION:

I am a reader of this magazine and never miss one, but I could not find as yet how telescopes are made.

I am interested in the study of stars and as telescopes for astronomical work cost much money, I would like to make one.

Will you please send me a sketch of a reflecting telescope and tell me how it is made? Also where to get necessary parts such as speculums, prisms, and lenses of all sorts?

I would like to make a 12-inch telescope, magnifying power well over 100 times or as high as possible.

JOHN HARASTE,
Binghamton, N. Y.

(SCIENCE AND INVENTION *Magazine published an interesting article on the construction of telescopes which appeared in this publication some years ago and is reproduced in the book called "How To Make it" which may be found on any newsstand. Another article appears in this issue. Note also telescope advertisers.*—EDITOR.)

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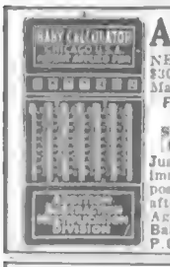

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The Astrology Humbug

By JOSEPH H. KRAUS

(*Continued from page* 800)

You have dared to throw the gauntlet at the feet of this ageworn science, now see if it is virile and strong enough to meet your challenge and place before the world the proof of the power of planetary and Zodiacal influences to mold and shape the destiny of worlds, nations, and individuals, we so badly need in this so-called enlightened age.

Wishing you all success and good luck.

A Searcher after Truth,
A. HARDIE,
Cannon Beach, Ore.

(You will note that in the November issue of SCIENCE AND INVENTION *Magazine, we published the horoscope as drawn up by Keva Deo Griffis. Mrs. Griffis is a recognized authority in the astrological field. We are not getting after anyone in particular. This publication is attacking the entire field of astrology until such time as it can prove its worth and our invitation to enter the contest is hereby extended, also to each and every individual member of the Brotherhood of Light and the Rosicrucian Fellowship as well as to each society as a whole. Undoubtedly the financial gain which either of these societies would get by actually wining the prize contest, due to the fact that the horoscopes which they might draw up, might be accurate enough to cause the judges to award them the prize; is too small an amount for a big organization to become even remotely interested. But the attendant publicity would be of inestimable value to these organizations: We know that the sum of* $6,000.00 *is as nothing to a big organization, but international advertising for the successful astrologer which of course would necessarily follow his winning the award, could not be paid for in dollars or cents. We again repeat that the contest for astrology is open to each and every individual on the face of this globe as well as to committees, clubs or societies of astrology.*—EDITOR)

WHY ATTACK ASTROLOGERS?

Editor SCIENCE AND INVENTION:

As I hold no retainer for astrology and as your prizes go only to those who prove the infallibility of astrology, I fancy this letter will go to the wastebasket "unwept, unhonored, unsung," and unrewarded.

But it strikes me as a layman, that SCIENCE AND INVENTION is asking too much of astrology or any other science (?) to prove its exactitude by factors which are outside of its sphere. It is quite true that "Twice two does make four in the abstract; and scientifically twice two units of anything may be presumed to make four units of that particular class of objects in the mind of the observer. But I submit that twice two editors or twice two women might not make four editors or women both at the Atlantic side and the Pacific side of this country with anything like similar results for the mathematical operation.

In fine, the world is full of facts, accepted by everybody as nearly enough to exactness to satisfy all but the most technical minds, that are not provable by any method capable of scientific demonstration. For instance, the variations of the meaning of the word SWEET—sweet music, sweet meat, sweet children, sweet perfume, sweet tobacco, sweet air, etc., etc. How would SCIENCE AND INVENTION prove exactly and scientifically that sugar dropped on the tongue caused the exact taste sensations to two different persons. Again the editor of SCIENCE AND INVENTION as he sits at his desk is wearing several garments. Can he tell to a mathematical exactitude the number of buttons on all these garments without counting them and if he is able to do so, will he give his readers assurance that all editors of scientific journals in all parts of the world will be wearing a similar number of garments while at their work secured with a similar number of buttons?

The sun and moon are known to affect, if not to cause, the tides in our Earthly oceans of water. Is it not equally probable that they cause similar shrinking and swelling in our atmospheric envelope? If so then the weather of this planet would no doubt be in a measure controlled by the co-operative or antagonistic gravitational attraction of the sun and moon. These elements have enabled scientists to not only predict ebb and flood tides to the minute in all parts of the world, but sometimes wind so affects the tides as to add or subtract minutes or hours from the calculated time of the culmination of the phenomena, yet I do not think SCIENCE AND INVENTION would question the reliability of the whole science of almanac making on that account.

Predictions of weather by Meteorologists has become a science remarkable for its utility, but the best of these gentlemen cannot tell why storm centers collect in certain places and not in others. Is it not possible that the stars or planets may, when in certain positions, exert their gravitational force (or some other force which we have not as yet discovered) which, by adding to or subtracting from the normal force of the sun and moon, causes, these storm centers to form on one part of the earth's surface at one time and at another on another occasion? These unaccountable changes in the weather affect animal and vegetable life in

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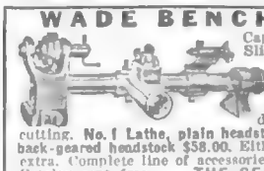

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different parts of the world differently on the same date. For instance, a season of bad weather at the hatching time of the ruffled grouse this year over quite a scope of country prevented practically any young grouse for sportsmen here while 100 miles away to 300 miles away the weather seemed favorable. Why the inexactitude?

Real astrologers (so far as I know) assert none of their predictions as infallible. If they did and could predict future events with infallible exactitude ther usefulness (?) would cease for the occurrences of the future would be fixed and immutable and astrology would then be the only exact science in the world, and the events foretold by its professors would be so exact and unescapable that its practitioners would be regarded with horror by all the common people.

Again, why pick on astrology as being inexact? You question astrology because two women indissolubly united prenatally did not altogether live duplicate lives, although born at the same moment and under presumably the same astral influences. No astrologer so far as I know predicts events or tendencies in the nature of any individual that are entirely inescapable and indeed the general tendencies of horoscopes is advice and warning to strive against influences that will tend to bring about certain untoward events, and to outline a time when these tendencies will be at their flood and resistance must be at its greatest. That some of their predictions contradict apparently is no more strange that the contradictory behavior of the individuals themselves when under the influence of impulse or whim. These two women had two different brains and otherwise were two different individuals, and though born under the same astral influences (?) they were gifted with fragmentary parts of the temperaments of a thousand generations of ancestors and may each have selected unconsciously characteristics of an entirely different set. These inherited tendencies may have been so strong in one or so weak in the other as to account for the resistance of one and the yielding of the other to the astral influences (if such there be).

Wheat grains grown in the same head under the same influences of soil, water, sunlight, and weather taken from that head and planted in similar soil, will vary in yield and otherwise. This variance is taken advantage of by breeders of plants and domestic animals to improve the kind. The tendency both in plants and animals (perhaps the result of astral influence) which has to be continually guarded against is to revert to the primitive type of the same plant or animal. SCIENCE AND INVENTION (perhaps whimsically) points out that the Woolworth Building at the distance of several blocks would have about the 15 squillionth (*"Squillionth"?—Ed.*) part of a pound attraction for a person. Now I don't want to bet any money on the accuracy of the idea, but I will venture the statement it would make all the difference in the world who the person was if the person was a bargain-hunting woman with ten cents and carfare in her pocket the attraction would defy all the pressure meters in SCIENCE AND INVENTION office to control or weigh the result.

Why discount the influence of the stars whether we can explain it or not when the Holy Writ tells us—Judges 5:20—"The stars in their courses fought against Sisera." Again in Job 28:3, "Canst though bind the sweet influences of the Ple—ia—des?" SCIENCE AND INVENTION would not condemn the whole medical profession because some noted doctor diagnosed ivy poison for small-pox, nor would he condemn the whole dairy business because the milk was sour some hot morning.

Your money is safe for it is as impossible to demonstrate to your satisfaction the influence of the stars on your life (if any) as it is to demonstrate that you have a pair of kidney by taking them out and showing them to you and then have you go about demonstrating similar facts to other people. We accept the doctor's testimony on a great many facts of that kind, and we don't expect him to demonstrate any more often than he has to and we usually object to a whole lot of publicity about the matter unless we happen to be a woman of the kind that insists on giving the details of the operations which she has enjoyed. If astrology is a humbug, why not let it hum? There is a fool born every minute and nobody ever heard of one dying; and the prayer of each of them seems to be "Give us this day our daily delusion."

J. R. PATTERSON, Newport, Wash.

(The only reason that this publication has gotten after astrologers is because of the astrologers themselves. This publication has been partially dedicated in its career to the exposing of fraud. Fraud spiritualists, fraud medicine men, fraud astrologers and any other form of fraud which can be exposed. Had it not been for the glowing claims of some of the astrologers to be able to do the impossible, SCIENCE AND INVENTION *would never have entered upon their grounds. Some astrologers are charging ridiculously high prices for a lot of bombast.*

Astrologers claim that their science is very old and that it is exact. Most of them even advise that they are infallible, yet when they are cornered they will state that "the stars incline but cannot compel." The newspapers today are full of astrological nonsense and we are of the opinion that the quicker the average individual learns that this form of fortune telling is not scientific, the better it will be for him. There are just as many places in the Bible where the untruth of astrology is indicated. The tale of Essau and Jacob is a good example, but it is not the only one.

Also, you must remember that at the time these books were written, astrology was in great favor. Each court had its own astrologer.—EDITOR)

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COPIES CODE WHILE ASLEEP

From *John o'London's Weekly* (London, England,) March 6, 1926.

Sir:

Lord Riddell, in his article, "The Hundred Per Cent. Shorthand Typist," in your issue of Feb. 20, relates the story of how W. B. Gurney took down a part of a speech while asleep. A very similar experience was mine during the war.

My duties as a wireless operator at divisional headquarters consisted, among other things, in listening-in to the German communiques as broadcast by POZ every evening, and taking a copy to the General's own office.

One night, after a particularly fatiguing spell of duty, I fell asleep during the transmission of the report in question. As my head drooped, my pipe, which was still held between my teeth, struck the desk. The impact woke me up, only to realize that POZ had long since closed up.

On reading through what I had taken down, great was my surprise to find that the whole message was there, down to the very AR. VA which terminates all Morse telegrams. My fingers had transcribed of their own accord the words dictated by my ears!

Yet I should not be surprised to hear this phenomenon had been experienced by other operators. The Morse code has such a way of pervading one's remotest circumvolutions!

Yours, etc.,

G. A. VINCENT,

Bleak House, Camberley.

(Editor's Note: The above communication was sent to the editor by Mr. G. A. Vincent of Bleak House, Camberley, England, and this proved very interesting reading, for the editor had suggested this method of utilizing the subconscious thinking powers of the brain while asleep way back in 1911, *in his story "Ralph* 124 *C* 41 *+." The editor has tried experiments along these lines with more or less success several times in the past fifteen years, and an article appeared in both* RADIO NEWS *and Science and Invention about two years ago, describing and illustrating the experiments conducted by the U. S. Navy Department with a number of radio operators. It was found that the operators learned the radio code more rapidly than ordinarily, when the signals were impressed on a pair of head phones clamped over the students' heads while they slept at night. There seems to be present in these experiments the germ of a great future development in the realm of mental science.)*

The "N" Circuit set is omitted this month due to further research work. It will appear soon.

The Shape of the Moon

By DONALD H. MENZEL, Ph.D.

(Continued from page 788)

actual quantity of matter is the same, whether along line a, b, or c. That is, the average density of the crust underlying the mountains is less than the average density of the part beneath the oceans. (Fig. 6). It is this force which causes the moon to be lopsided.

The amount of deformity is, however, greatly exaggerated in the diagram, and in actuality is so small that the difference between the moon's true shape and a perfect sphere is far too minute to be detected by telescopic observations.

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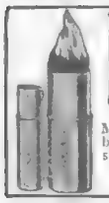
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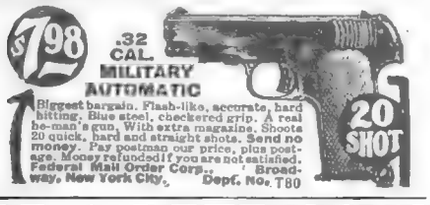

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Building Your Own Telescope

(*Continued from page* 814)

though the telescope which the editors constructed is equipped with a six-inch reflector, a mirror polished and ground on its upper surface and then coated with silver, so as to provide as nearly a perfect reflecting surface as is possible; all of the information concerning it is also applicable to the construction of a telescope employing a four-inch reflector, but of course the sizes of the tube and the stand should be decreased proportionately. The average experimenter's weakness is of course his pocket book. If he is a true experimental fanatic, his funds generally go into experimental apparatus.

The average person does not care to grind his own lenses and speculum. This entails a certain amount of work and quite a bit of careful testing in order to get a perfect piece. The speculum for this telescope was purchased already mounted in its wooden case. By so doing the telescope was completed in a much shorter space of time.

The next thing in order was the formation of the tube for the mounting of the telescope. Here it is necessary to determine the size of the tube. Let us assume that the individual has before him a speculum of 4 or 6 inches in diameter and also that he does not know its focus or the focus of the eye-piece which he intends to employ. It is a relatively simple matter to obtain the focus of any concave mirror by the ordinary means of watching for the concentrated spot of reflected light, but this method is unsatisfactory and not very accurate. The system of finding the focus and measuring this by a ruler is probably preferable. The speculum is placed upright on a table and facing an open window. The eye-piece is then slowly moved back and forth to obtain a view of the lens and at the same time an inverted image of some distant object. For practical purposes, this test should be performed with an object approximately one-half mile away such as a tree or a steeple. Having obtained the aggregate focus of both speculum and the eye-piece the distance between the two is now measured and the tube made accordingly.

The tube can be made of any of a number of materials; it may be cardboard, several layers of wrapped paper, wood, or as in our case, sheet iron. A piece of galvanized iron was obtained from the tinsmith, bent over and soldered along the seam. Galvanized iron is quite heavy and in its place, ordinary stove-pipe can be used which should be bound with strips of copper so as to make it more secure. Three grooves were cut into one end of the pipe for the mounting of the mirror, and the eye-piece was fastened 4 inches from the other end of the pipe. Directly opposite the eye-piece a 3-inch strip of copper was secured to hold the diagonal mirror, and the mounting of sheet brass was made for the mirror. This latter mirror may be obtained from any novelty shop and the builder should take care to see that the top surface of the glass is as perfect as can possibly be secured, because the mirror is to be silvered on the top surface and it reflects light from this surface. This mirror is 1½ inches long and 1 inch wide. Removing the eye-piece and looking down through the eye-piece-mounting at the mirror, the angle of the mirror was so adjusted that it reflected the interior of the tube giving a view of the open end. The speculum fitted with wing-nuts as indicated in our diagram was now slipped into place and with the eye-piece still removed, the speculum was adjusted so that the reflection of the mirror appeared to be directly in the center of the speculum. It is of course understood that the protractor for reading the angle of the telescope has already been locked in place

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by means of the bolts fastened through the side walls of the telescope tube, the position for which has been determined by balancing the tube between the fingers with the speculum and eye-piece in place. A slight adjustment of the eye-piece or of the mirror or both will now enable the observer to use the telescope if it is mounted on any form of a support. The type of support employed will largely influence the cost of the completed telescope.

We have accordingly shown four different forms of telescope mountings. The first is the simplest kind of a mounting which could possibly be made. This consists of a wooden post which may be driven into the ground vertically or which may be supported on a wooden platform by four braces. A U-shaped iron strap is bolted fast to the top of the post, the angle of the top being cut to suit the latitude of the builder's location. By doing this, the builder will have produced what is technically known as an equatorial angle. The purpose of the equatorial angle is seldom explained. The angle between the polar axis of the telescope and the northern horizon as stated before must equal the observer's latitude. When once this has been adjusted, it need never be changed unless of course, the telescope is moved to another latitude. The polar axis will now be found to be parallel to the earth's axis, even though the centers are thousands of miles apart. In observing objects millions of miles away, this distance makes no appreciable difference. It will now be found that by means of but one movement any star can be slowly followed. We can point the tube high in the skies or to the horizon. In either case, the polar axis is always performing the necessary motion to offset the earth's daily rotation and it is not necessary to follow the stars by a series of steps. When the telescope is pointed high in the heavens, the stars appear to move in a direction opposite to the motion of the earth and very slowly. The pole star (Polaris) seems to be practically standing still. When observing the moon, let us say near the horizon, the motion is remarkably rapid. In the first form of the telescope, no provision has been made to change the equatorial angle; in the second style, a slight adjustment is possible because of the slotted holes provided for lag screws. In this type of wooden mounting, the height of the telescope can be adjusted for various users.

The form of a mounting which this publication recommends is that indicated on the full page diagram. This is made of pipe flanges and two pieces of iron pipe, the outer one 5 inches in diameter, and the inner pipe, 4½ inches in diameter. Holes are provided in the 5-inch iron pipe for regulation of the height and a threaded rod for adjusting the equatorial angle is also found in this particular form of construction. When it is desired to use the telescope for observing things on the surface of the earth, the equatorial angle need not be changed. The lock bolts passing through the 5-inch pipe and settling into a shallow groove cut in the 4½-inch pipe are loosened permitting the entire structure to be swung around on its vertical axis. This arangement enables our telescope to be used for two purposes, namely observing the heavens and also examining things more earthly. It is not necessary that a groove be formed in the inner pipe because a mark chiseled on this pipe and making a straight line with a similar mark on the outer pipe will serve to line up the two portions very quickly. For operating in dark quarters, the groove will assist in feeling for the required position. The lock bolts of course are only loosened when the telescope is not to be used for celestial observation.

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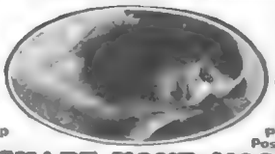

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BOOKS—If you want good books on radio, electricity or science, consult the Book Review Section starting on page 865 of this issue.

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pointers give us a reading on two protractors. These protractors were obtained in a stationery store. It will be noted that in observing the heavens, the telescope may be aimed high or low after which it is swung on its equatorial axis.

The speculum of the telescope, when purchased, will be found to be silvered on its upper surface, and should therefore be handled very carefully so as not to damage the silver coating. Even though this coating may be tarnished in appearance, remember that the worst tarnished surface of a glass mirror is far superior to the best high polished surface on a metal mirror. In event that through accident or otherwise the speculum mirror is destroyed, and also for the purpose of enabling the builders to silver the surface of the diagonal mirror, the following instructions for silvering of mirrors is given.

In the silvering of mirrors distilled water should always be used in mixing any solution. It is also advisable to have the surface of the glass to be silvered of a slightly higher temperature than the solution itself. Cleanliness of the surface of the glass to be silvered is of prime importance. A perfect surface cannot possibly be secured if there is a slightest bit of grease on the glass. This surface of the glass can be advantageously cleaned by rubbing it with some very fine rouge. The rouge may be moistened with water. This having been done, the rouge is washed off, but the hands must not touch the mirror. Use a small soft brush for this purpose like a tooth brush. Some powdered stannous chloride is now dissolved in water and this is flooded over the surface of the mirror which may be sponged with a tuft of cotton and with the stannous chloride solution. Wash the mirror with clear water for a few seconds and then proceed with the silvering process.

This method for silvering mirrors is known as the *Rochelle Salts Process.* Ten grams of silver nitrate are dissolved in 100 grams of distilled water. To this concentrated ammonia is added until the precipitate first formed is just redissolved. Care should be used to mix the solutions well. Now, drop by drop of a 10% solution of silver nitrate is added until the entire solution becomes opalescent. Enough distilled water is added to make one liter, it is filtered and bottled. This may be labeled "solution A."

For "solution B" add 2 grams of silver nitrate to 1 liter of distilled water, and bring to a boil. Then add 1.66 grams of Rochelle salt (dry), boil five minutes, stirring all the time. Filter and keep in a dark colored bottle.

To use, mix equal parts of "A" and "B" at room temperature. Pour this on the surface of the glass, which if it is clean, will permit the solution to pile up to a height of at least one-eighth of an inch without pouring over the sides or edges. The work should be done quickly because the silver deposits quite rapidly if the glass has been warmed. The silver coating may not always be as perfect on the top surface of the glass due to oxide formation as if it is silvered on the under surface. The refraction of the glass and the formation of double images is of greater hindrance than the tarnished surface. In using rubber gloves, be careful that the rubber does not come in contact with the mirrored surface, because the sulphur in the rubber will tarnish the mirror more rapidly.

TOOLS REQUIRED

1 soldering iron.
1 breast drill.
1 set of drills.
1 hacksaw.
1 pair of tin shears.
2 S-wrenches or
2 monkey wrenches.
1 large pipe wrench (not essential but recommended).
1 knife.
1 tap and tap wrench (No. 8—32)

Names of the manufacturers of telescope parts may be obtained upon request.

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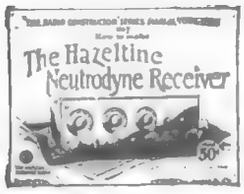

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TIPS FOR THE RADIO AMATEUR CONSTRUCTOR, by E. V. Church, 48 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

The reviewer of this book has had a tendency to do much of his own work in the experimental line at home. Sometimes it seems as if it were really not worth while, as if it would be better to go into the store and buy outright what you want, but you are never sure of what you are getting in the stores, and when one builds a set for himself its a great comfort to know that the joints are adequately soldered, that there is no shake in the condenser bearings, and that everything from one end of the set to the other is right. The limited number of pages in this book have been supplemented in a certain sense by the use of small type, and there is such an atmosphere of practicability and mechanical practice of the better order, that it makes extremely interesting reading. Even the grinding of a twist drill to prevent the chipping of the panel is considered. Soldering is given in an excellent way, and even the right and wrong way of making a loop at the end of a wire for making screw connections is described and illustrated. Everybody who works at home will find valuable tips in Mr. Church's book.

THE RADIO TROUBLE FINDER, by the Staff of Radio News, 47 pages, published by the E. I. Co., 53 Park Place. New York City. Price 25 cents.

The staff of RADIO NEWS are all practical radio men, and here we have trouble finding discussed by what we may term a board of experts. An excellent example of the treatment can be found in Chapter Two, which gives what is termed a chart for locating trouble in a radio receiver in which a long classification according to general symptoms is given, and in each case a number for the special test is indicated and these tests each under its own number are contained in the succeeding chapter. Nothing could be clearer or simpler. Another interesting point is that the tests with some exceptions are individually illustrated by diagram so as to make them at once understandable by little more than inspection.

LOUD TALKERS—HOW TO BUILD THEM, by H. W. Secor, 48 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

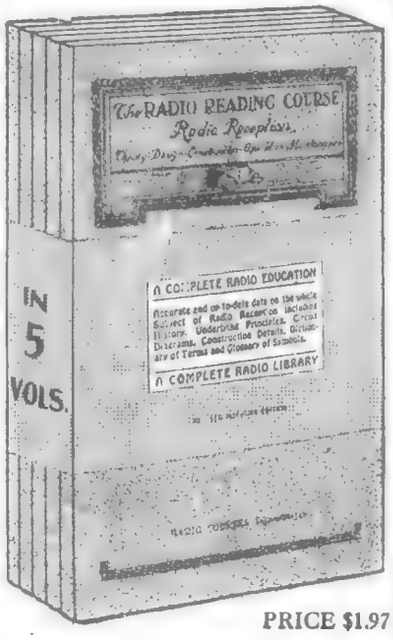
The key-note of this book is practical construction, home work, the utilization of simple materials to produce the key-stone of radio in the home, which is the loud speaker. All through the pages we feel that the distinguished author is telling of what he has done himself, and this certainly gives the work the personal touch so much to be desired in literature. We gladly recommend the work to our readers.

RADIO QUESTIONS ANSWERED, A. P. Peck, 48 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

The author of this book for some years on the staff of SCIENCE AND INVENTION is a well-known authority on radio, and for some years was appealed to by our readers for all sorts of information on the subject. Much of the information sought for was published in the same magazine, some of it was sent by letter, for it has always been the desire of the editors of SCIENCE AND INVENTION magazine to help out radio experimenters in their trouble. In this book we have over eighty questions which have been put to the magazine with Mr. Peck's answers. Mr. Peck acquired quite a reputation among the devotees to the science and his clarity of statement and briefness of answer give the book unusual value. Numerous illustrations clarify all difficult points.

HOW TO MAKE PRACTICAL RECEIVING SETS, by W. G. Many, 46 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

Undoubtedly, a very large proportion of home-made sets have proved far from practical. There is no doubt that in the construction of poorly working sets, the amateur has learned a great deal about the troubles of the science, but here we find Mr. Many the Managing Editor of RADIO LISTENERS' GUIDE & CALL BOOK combined with RADIO REVIEW telling us how to construct "practical" sets and depicting and telling about various details of the absolutely practical features involved in the construction. From one end of the book to



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the other, the practical points of construction, down to the drilling of the panel, the lead-in, the ground connection and the like are all given in detail so that when reading it one feels quite competent to do his own work.

ALL ABOUT RADIO PARTS, by Thomas W. Benson, 48 pages, published by the E. I. Co., 53 Park Place, New York City Price 25 cents.

There are two things concerned in the construction of radio sets, one thing is the nature, and quality of the different parts. These include tubes, coils, condensers and such little details as bus wire, battery clips. The other part is what we are to do with them. Mr. Benson in this convenient little manual elaborates on the parts only, giving naturally a few diagrams, but the book is essentially devoted to starting the constructor off right on his material, and no advice has been more often given in the line of radio construction than the importance of using good material.

100 RADIO HOOK-UPS, by F. F. Webb, 56 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

It seems impossible that even so well known an authority as Mr. Webb should succeed in putting so many hook-ups into so small a volume, and it is really rather a crime that he was able to accumulate 100 quite distinct and individual arrangements of a radio receiving set. The book contains suggestions for an endless amount of experimenting. It starts with the simplest crystal hook-up embodying one condenser, one inductance, crystal detector and head-set, all connected (except of course the head-set) in series. Then adjustments come in, succeeded by crystal sets with additional parts, and at last in the seventh set we are introduced to the vacuum tube, and from there to the end of the book, it is all tube sets, up to the eight tube Superheterodyne receiver. We warmly commend the book.

HOW TO TUNE YOUR RADIO SET, by M. L. Muhleman, 46 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

This well-known author in his very clear presentation of the subject of tuning succeeds in bringing out not only the question of how to tune, but incidentally depicts the beginner's troubles only too picturesquely. After reading the book, the owner of a set will no longer be content to stand in front of a black panel and twist his knobs about until he gets something without knowing the how and why, but he will certainly want to know what he is doing, so to that extent the book will operate as an inciter to study.

HOW RADIO IS RECEIVED, by R. S. Ould, 47 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

It is really to be lamented that so many amateurs with their practical knowledge of radio do not grasp the basic principles upon which it is founded. But here in this convenient manual by a member of the United States Bureau of Standards, the theory is given, and it is entitled an Easy Course in Home Radio, and the statement on the title page to the effect that it is edited and approved by so eminent an authory as Major General George O. Squier, chief of the Signal Corps, U.S.A., gives it an authoritative value. We think that the reader will find in its easily read pages a very complete compendium of the relation of sound waves to the carrier wave sent out through space from broadcasting and transmitting stations.

THE NEUTRODYNE—ALL ABOUT IT, by M. L. Muhleman, 43 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

Mr. Muhleman, author of this book is very well known to the readers of RADIO NEWS and to the radio world in general. As a practical radio operator of long service and as a member of the editorial staff of RADIO NEWS, his book combines the touch of practicality all through the theoretical part of it. The title alone could serve as its review. In it with numerous illustrations and a convenient division into sections, the subject is very thoroughly covered. We would especially recommend such sections as the one headed "The How and Why of the Neutrodyne," for it is the "how and why" of the sets that so few amateurs adequately understand, even if they have built them themselves.

HISTORY AND OPERATION OF THE VACUUM TUBE, by J. H. Morecroft, 48 pages, published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

Here we have a little work by the Assoc. Professor of Electrical Engineering of Columbia University, edited and approved by General Squier, which will well repay careful reading. The full

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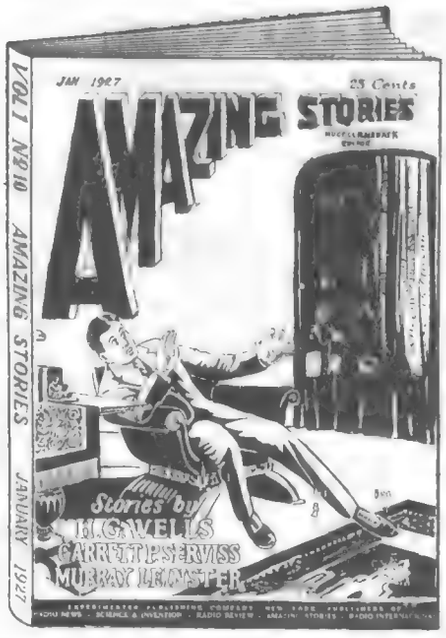

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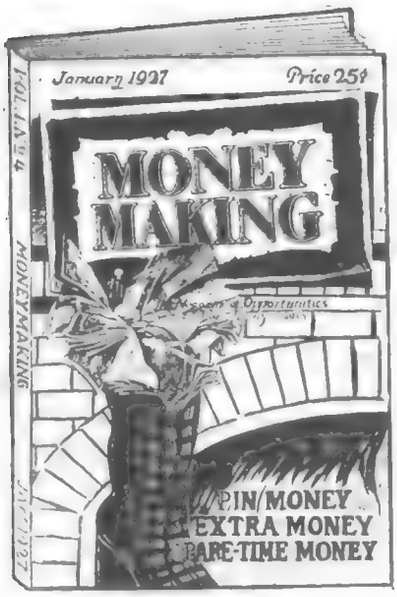

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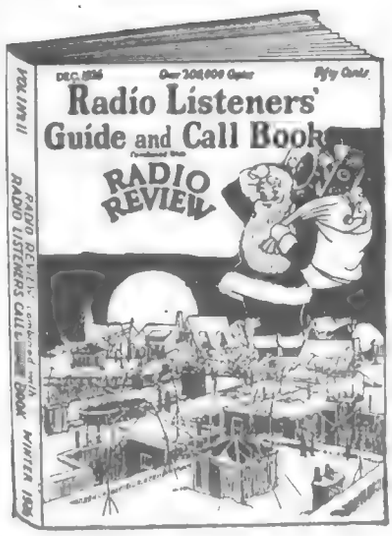

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Book Review

(*Continued from page 866*)

action of radio sets embodying such details as the tickler coil and the "C" battery are not thoroughly understood by most experimenters and this book is so clearly put that it will be safe to recommend it to all. We are glad to see in its pages that the "Edison effect" is noted for all modern radio work, broadcasting and receiving is based upon it, and the future development of a science which may truthfully said to be in its infancy, depends upon Edison's discovery of the action of plate and filament in a vacuum tube.

THE SUPERHETERODYNE THEORY AND CONSTRUCTION, by F. F. Webb. 48 pages. Published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

The interesting little manual gives the history of the invention of the Superheterodyne, perhaps the most popular hook-up, and one which has developed into various types. Such are described with numerous illustrations. This book in its ten chapters gives typical hook-ups, practical details of construction including the selection of accessories, conveying the information applicable to all amateur constructors, to the effect that it is always uncertain if a good set can be built up of any old parts. To which assertion the experienced reader will assert.

After this advice and in the next section, which is chapter seven, there is given a complete list of the parts required, exclusive of the bulbs. We cite this chapter as an example of the thoroughness of the little manual; in it each part is designated by a letter so that it can be located on the numerous diagrams on which the same lettering is followed.

REFLEX RADIO RECEIVERS, by P. E. Edelman, 51 pages. Published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

The reflex type of receivers of broadcasting has acquired considerable popularity, because fewer vacuum tubes, a large element of expense in radio sets, are required than in other sets. Theoretically, three tubes should do the work of six because of the reflex action, but in order to reach this proportion without howls, the theory of the system has to be understood and this book gives it at length. The illustrations are very numerous, and a convenient division of the chapters gives a practical touch to the book considered as a manual for the amateur constructor, and we doubt not that some who consider themselves professional builders will learn a great deal from its study and perusal.

HOW TO LOCATE TROUBLES IN YOUR RADIO SET, by Thomas W. Benson, 47 pages. Published by the E. I. Co., 53 Park Place, New York City. Price 25 cents.

On the cover of this book are shown three faces of the owner of a receiving set. One indicates his desperation in being unable to get any results. The second face shows that he is beginning to get something, and the third face, framed in by a head-set, shows by its happy cast that at last he has got rid of his troubles. As far as its limited pages permit it is a very thorough presentation of troubles, and by a very elaborate system of cross references, as we may term them, an almost wonderful clarity of statement is given; without hesitation, we commend the book to our readers.

EXPERIMENTAL ELECTRICITY COURSE, by S. Gernsback and H. W. Secor. Flexible cloth covers, 4¾" x 9", profusely illustrated, 160 pages. Published by The Experimenter Publishing Co., New York City. Price $2.00.

Every electrical student should have a copy of this very complete experimental electricity course prepared in twenty progressive lessons. You will find in this valuable, low priced manual a wealth of material which can be found nowhere else. Many electricians have found the book very valuable in their everyday work, as it was written by men of practical experience in the electrical field. Storage batteries, spark coils, motors, dynamos, X-rays, electro-plating, high frequency and static machines, are covered in an interesting and instructive manner with many valuable diagrams showing thoroughly and correctly the operating principles, so that the student may carry out directly many experiments of his own. One of the most interesting lessons in the work is that on telegraph and telephone apparatus. Do you know how to install an inter-communicating tele-

(*Continued on page 870*)

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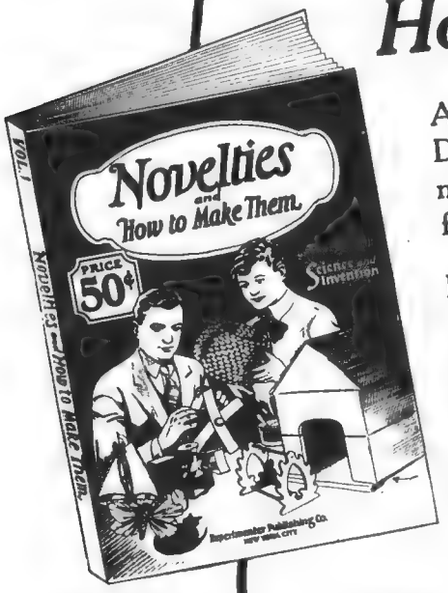

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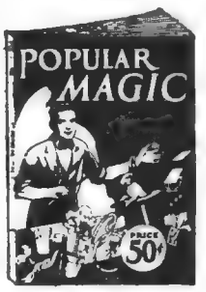

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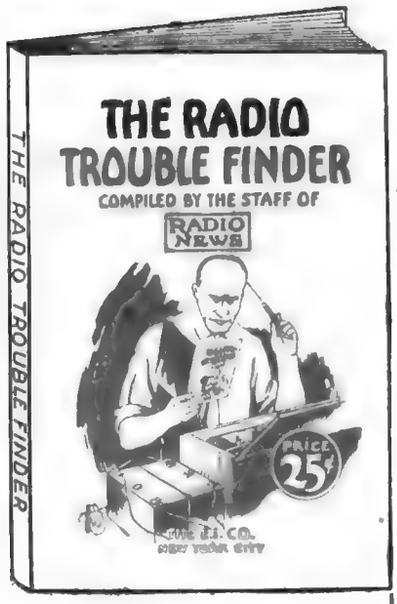

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Book Review

(Continued from page 868)

phone system in your home or office? This work tells you how. Another interesting lesson we note in passing is the eighteenth, describing electrical measuring instruments and how to use them. The chapter on electro-plating is particularly valuable and contains all the data necessary for nickel, and copper-plating.

WIRELESS COURSE IN 20 LESSONS by S. Gernsback, A. Lescarboura and H. W. Secor. Stiff leatherette covers, 5¾" x 9", profusely illustrated, 264 pages. Published by The Experimenter Publishing Co., Inc., New York City. Price $2.00.

This well-known compilation is a complete radio course in twenty lessons, and to judge its popularity in radio schools and clubs, and particularly for home study, suffice it to say that over 100,000 copies of this course have been printed in the various editions. This course was used in many of the Army and Navy radio schools during the World War to help as an aid in teaching enlisted men the principles of radio telegraphy and telephony.

The new edition has been brought up to date, and vacuum tube transmitters as well as receivers are explained with clear diagrams and photos. The book is written in such simple, understandable language that the youngest radio student can easily comprehend the meaning of the various explanations given. This radio course has a number of elementary lessons on electricity and magnetism, and also a chapter on elementary mathematics and formulae. A complete index and table of symbols appear at the end of the work.

RADIO REVIEW—RADIO LISTENER'S GUIDE AND CALL BOOK. Edited by S. Gernsback. Soft covers, 8½" x 11¾", profusely illustrated with diagrams and photos, 192 pages. Published by The Consrad Co., New York City. Price 50 cents.

This remarkable compilation of choice radio articles gathered from radio press, both in this country and abroad, is combined with a complete list of calls of radio stations in the United States and abroad. The radio station call list is cross indexed, so that one can find a station by location, or else by call, at a minute's notice. The radio station call pages are embellished with many interesting photographs of the principal artists, announcers, and other personnel of the various well-known radio stations. In the fall edition now out, we note some extremely well illustrated articles covering the latest style receiving sets, one article on Superheterodynes discussing which type is preferable. Other articles describe fully the building of B eliminators, T.R.F. sets, Superheterodynes, the improved Browning-Drake receiver, etc.

NOVELTIES AND HOW TO MAKE THEM. Compiled by the staff of SCIENCE AND INVENTION Magazine, edited by Joseph H. Kraus. Soft covers 8½" x 11¾", profusely illustrated with line drawings, 89 pages. Published by The Experimenter Publishing Co. Inc., New York City. Price 50 cents.

This valuable book on novelties and how to make them should find a place on the book shelf or library table of every home. There are hundreds of useful illustrated wrinkles in this book covering such subjects as home-made mission lamps, home-made telephone, Christmas toys, home-made bookcase, sensitive hygrometer, miniature volcano, burglar and fire alarms, electric poultry feeder, uses for old cigar boxes, uses for old films and clock springs, and dozens of other wrinkles which the man of the house, as well as his wife and children, will find entertaining and useful.

500 RADIO WRINKLES. Compiled by the staff of RADIO NEWS, edited by Leon L. Adelman. Soft covers, 8½" x 11¾", profusely illustrated, 94 pages. Published by The Experimenter Publishing Co. Inc., New York City. Price 50 cents.

The person who buys such a book as this gets his money's worth many times over, for the work is edited with great care and only the most practical and useful ideas are illustrated and described. This book is divided into sections covering such vital subjects of interest to every radio fan as antennae, condensers, batteries, inductances, crystal detectors, loud speakers, lightning protectors, coil mountings, sockets, resistances, switches and transformers. We note also a very interesting section on vernier dials. This book is worth many times its price to any radio man, whether amateur or advance student.

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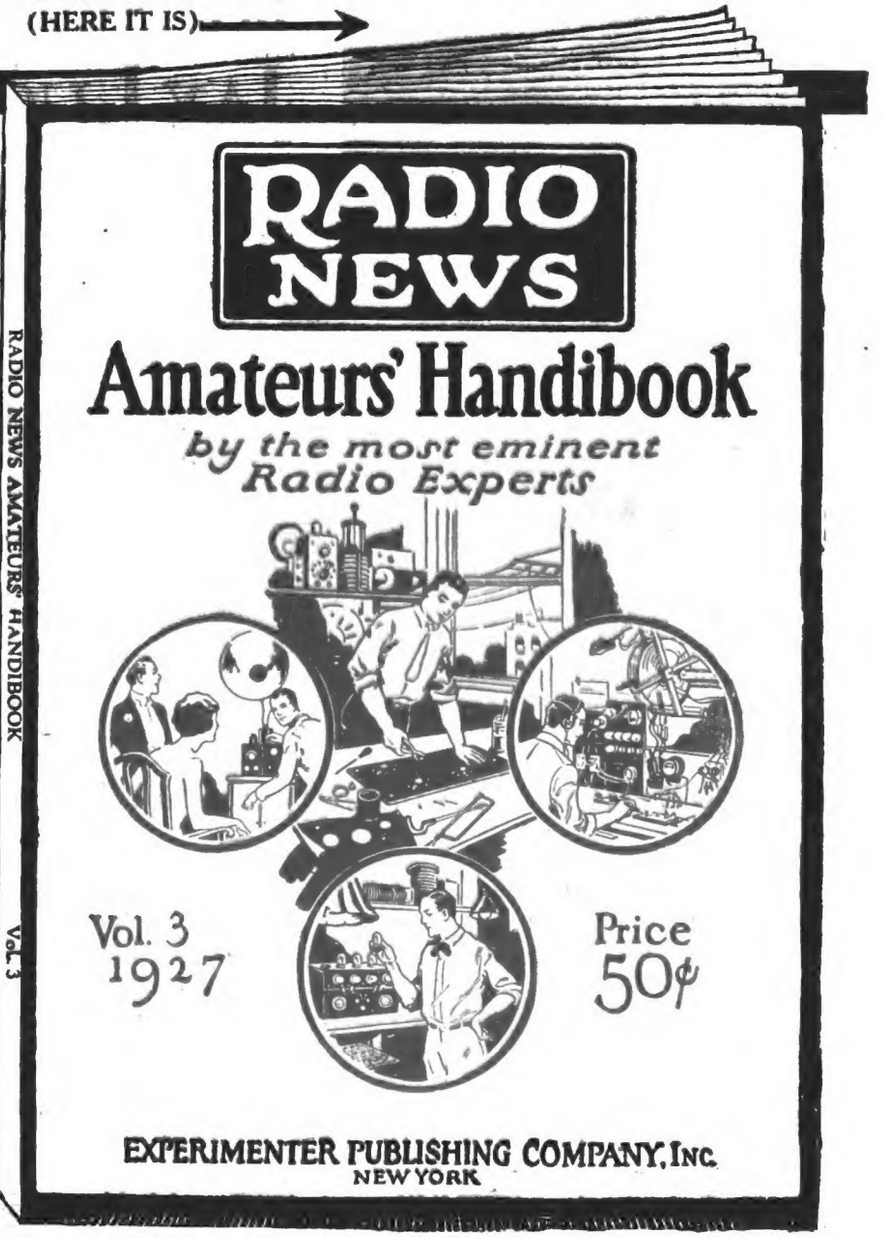

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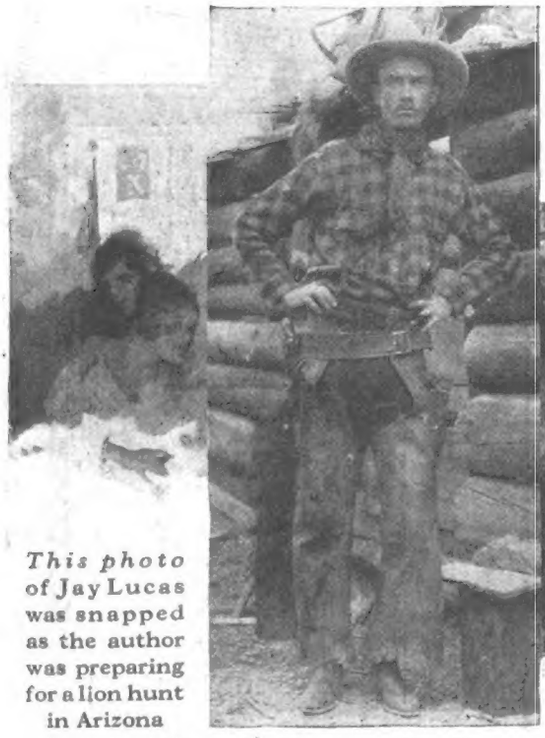

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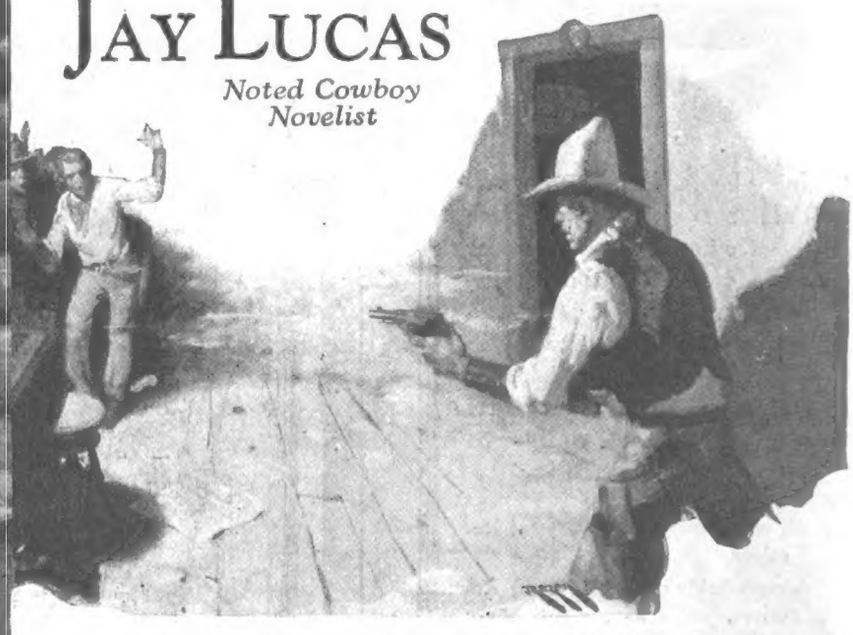

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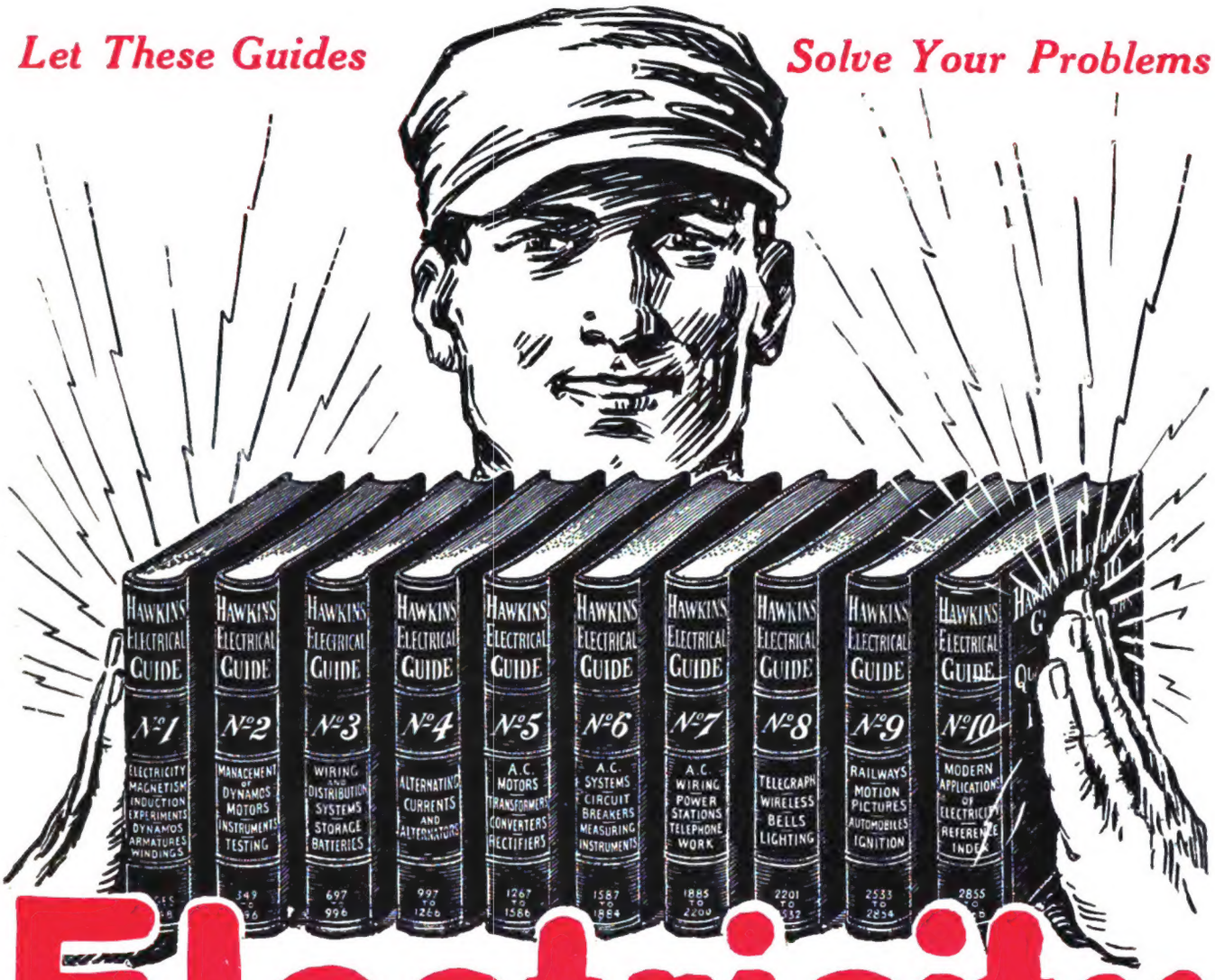

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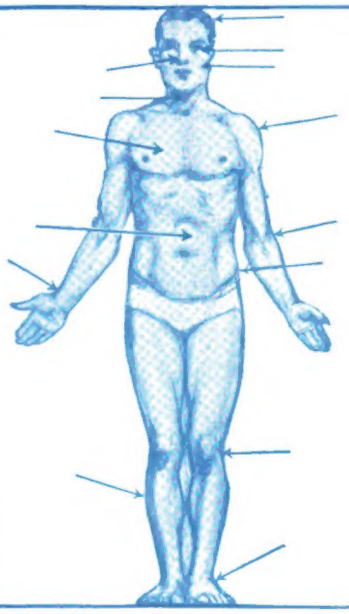

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